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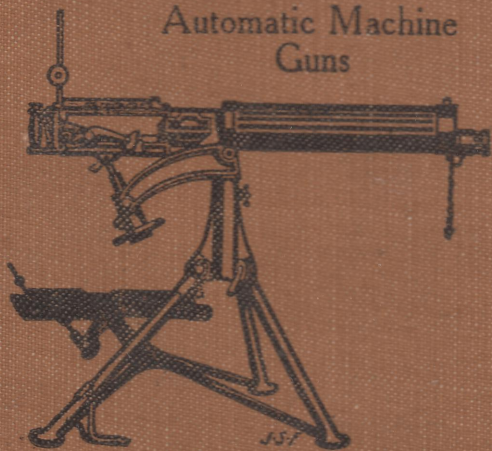
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THE  
Machine Gunners'  
Handbook

Including the  
Vickers and Lewis  
Automatic Machine  
Guns



Arranged by  
Lieut. J. BOSTOCK, K.O. Yorkshire L.I.  
(Machine Gun Corps)

ELEVENTH



EDITION

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NER'S

ARD WITH  
SIZES OF  
II. AMMU-

lope of Descent  
Last 100 yards.

	In Minutes.
—	—
—	—
230	15
149	23
107	32
82	42
64	54
50	69
39	88
31	111
25	139
20	172
16	209
14	251
12	298
9.8	350
8.5	407
7.3	469
6.4	541
5.5	623
4.8	715
4.2	817
3.7	929
3.3	1,052
2.9	1,186
2.6	1,332
2.3	1,491

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# THE MACHINE GUNNER'S

RANGE & TRAJECTORY CARD WITH  
ANGLES OF ELEVATION, SIZES OF  
CONES, ETC., FOR MARK VII. AMMU-  
NITION.

Range.		Vertical Diameter from Mean Trajectory to Lowest Shot in Cone.	Slope of Descent in Last 100 yards.	
Yards.	Minutes.	Yards.		In Minutes.
100	3	—	—	—
200	7	·7	—	—
300	11	1·0	—	—
400	16	1·3	1 in 230	15
500	22	1·7	1 in 149	23
600	28	2·0	1 in 107	32
700	35	2·3	1 in 82	42
800	43	2·7	1 in 64	54
900	52	3·0	1 in 50	69
1,000	62	3·3	1 in 39	88
1,100	73	4·0	1 in 31	111
1,200	86	4·7	1 in 25	139
1,300	101	5·3	1 in 20	172
1,400	117	6·0	1 in 16	209
1,500	135	6·7	1 in 14	251
1,600	155	7·3	1 in 12	298
1,700	177	8·0	1 in 9·8	350
1,800	201	8·7	1 in 8·5	407
1,900	227	9·3	1 in 7·3	469
2,000	256	10·0	1 in 6·4	541
2,100	288	13·3	1 in 5·5	623
2,200	322	16·7	1 in 4·8	715
2,300	360	20·0	1 in 4·2	817
2,400	401	25·0	1 in 3·7	929
2,500	447	30·0	1 in 3·3	1,052
2,600	496	35·0	1 in 2·9	1,186
2,700	551	41·7	1 in 2·6	1,332
2,800	610	48·3	1 in 2·3	1,491

# TRAJECTORY TABLE.

		Height in Yards of Centre of Cone above Line of Sight at :--																									
Range yards		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
300	0°3																										
400	0°5																										
500	0°9																										
600	1°2	14	13	13	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	
700	1°5	21	20	20	20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	
800	2°0	26	25	25	25	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	
900	2°6	32	31	31	31	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	
1000	3°2	43	43	43	43	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	
1100	3°9	54	54	54	54	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	53	
1200	4°6	65	65	65	65	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	
1300	5°5	78	78	78	78	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77	
1400	6°6	93	93	93	93	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	
1500	7°3	107	107	107	107	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	106	
1600	8°7	127	127	127	127	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	
1700	10°0	143	143	143	143	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	142	
1800	11°3	167	167	167	167	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	
1900	13°0	197	197	197	197	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	196	
2000	14°3	213	213	213	213	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	212	
2100	16°3	243	243	243	243	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	242	
2200	18°3	273	273	273	273	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	272	
2300	20°0	307	307	307	307	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	
2400	23°0	347	347	347	347	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	346	
2500	25°7	387	387	387	387	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	386	
2600	28°7	427	427	427	427	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	426	
2700	31°3	467	467	467	467	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	466	
2800	35°3	507	507	507	507	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	506	

## Searching Reverse Slopes.

### GENERAL METHOD.

1. From contoured map find angle of reverse slope.
2. Find angle of sight between gun and crest.
3. Combine angles found in 1 and 2, and inspect tables shewing angles of descent of bullets in last 100 yards
4. Select angle of descent from the table equivalent to angle found from combining 1 and 2.
5. Note distance for gun giving this angle, and move gun to this range from crest.
6. Order 50 to 100 yds. extra elevation (according to distance) to ensure the whole cone clearing crest.
7. Aim at the crest and fire.

## THE MACHINE GUNNER'S TRIANGLE.

To find the angle of sight between the gun and target. Note from contoured map *the difference* in height between the gun position and target. Convert the height thus obtained into an angle by the formula :—

$$\frac{\text{V.I. (in feet)} \times 20}{\text{H.E. (in yards)}} = \text{Angle of sight in degrees}$$

# TABLE OF ALLOWANCES FOR ATMOSPHERIC INFLUENCES.

## FACTORS.

More Elevation.	Less Elevation.
Extreme dryness.	Rain.
Cold (40° Fahr.)	Heat (80° Fahr.)
Head wind (strong).	Rear wind (strong).

## ALLOWANCES.

Range.	One Factor.	Two (or more) Factors
Yards.	Yards.	Yards.
1,000 or below ..	Nil.	50
1,000-1,500 ..	50	100
Beyond 1,500 ..	100	150

## WIND TABLE.

### FOR RIGHT-ANGLE WINDS.

Range.	Mild.	Fresh.	Strong.
Yards.	Yards.	Yards.	Yards.
500	1	1½	2
1,000	3	6	9
1,500	6	12	18
2,000	12	24	36

For oblique winds allow half the above.

## SIZES OF EFFECTIVE BEATEN ZONES IN YARDS.

Range.	Width.	Length.
500	·8	220
800	1·3	172
1,000	1·7	140
1,200	2·3	112
1,500	3·3	75
1,800	5·3	70
2,000	6·7	70

Beyond 2,000 yards the Zone increases in both Width and Length.

## TO BE HELD AT FULL EXTENT OF ARM.

### SAFETY ANGLES FOR OVERHEAD FIRE.

Target line \_\_\_\_\_

30' \_\_\_\_\_

60' \_\_\_\_\_

100' \_\_\_\_\_

### GRATICULES.

Zero \_\_\_\_\_

200 \_\_\_\_\_

400 \_\_\_\_\_

600 \_\_\_\_\_

800 \_\_\_\_\_

1,000 \_\_\_\_\_

1,200 \_\_\_\_\_

1,400 \_\_\_\_\_

1,600 \_\_\_\_\_

1,800 \_\_\_\_\_

2,000 \_\_\_\_\_

*The "Kingsway" Service Series.*

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Including the  
Vickers and Lewis  
Automatic  
Machine Guns

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## CONTENTS.

	PAGE
I. Introductory . . . . .	vi
2. Essentials for Machine Gun Instructors . . . . .	I
3. General Principles of Training . . . . .	5
4. Organisation of Machine Guns . . . . .	9
5. General Description (Vickers) . . . . .	10
6. Action of the Mechanism . . . . .	27
7. Stripping (Vickers) . . . . .	42
8. Examination . . . . .	50
9. Stoppages . . . . .	53
10. Care and Cleaning . . . . .	72
II. Points Before, During and After Firing . . . . .	77
12. Allocation of Duties . . . . .	84
13. Belt Filling . . . . .	90
14. Elementary Drill . . . . .	93
15. Tests of Elementary Training . . . . .	107
16. General Machine Gun Course s . . . . .	116
17. Advanced Drill . . . . .	131

	PAGE
18. Trench Drill . . . . .	136
19. Limber Drill . . . . .	139
20. Characteristics . . . . .	146
21. Fire Direction . . . . .	155
22. Combined Sights . . . . .	163
23. Direct Overhead Fire . . . . .	177
24. Indirect Fire . . . . .	187
25. Use of Spirit Level . . . . .	189
26. Graticules . . . . .	191
27. Map and Compass . . . . .	195
28. Barrage and Long Range Searching Fire . . . . .	197
29. Testing Clinometers . . . . .	209
30. Night Firing . . . . .	214
31. Searching Reverse Slopes . . . . .	216
32. Barrage Fire . . . . .	218
33. Notes on Lewis Gun . . . . .	224
34. General Description (Lewis) . . . . .	230
35. Mechanism (Lewis) . . . . .	245
36. Stripping (Lewis) . . . . .	248
37. Stoppages (Lewis) . . . . .	258

## LIST OF PLATES.

	PAGE
1. Vickers Gun . . . . .	19
2. The Lock . . . . .	21
3. Vickers Gun . . . . .	23
4. The Lock . . . . .	25
5. Feed Block . . . . .	37
6. Belt Filling Machine . . . . .	92
7. Elementary Drill . . . . .	96
8. Cones of Fire . . . . .	156
9. Ranging Errors . . . . .	161
10. Combined Sights . . . . .	165
11. Combined Sights . . . . .	166
12. Combined Sights . . . . .	169
13. Searching . . . . .	175
14. Searching . . . . .	176
15. Direct Overhead Fire . . . . .	180
16. Direct Overhead Fire . . . . .	182
17. Vertical Cones . . . . .	185
18. Graticules . . . . .	193
19. Clinometer . . . . .	210
20. Night Firing . . . . .	217
21. Lewis Gun (Exterior) . . . . .	227
22. Lewis Gun (Interior) . . . . .	240
23. Lewis Magazine . . . . .	241
24. Lewis—Barrel Group . . . . .	242
25. Lewis—Body Group . . . . .	243
26. Lewis—Feed Mechanism . . . . .	244

## INTRODUCTORY.

These Notes show, in some measure, the system followed at the Headquarters of the Machine Gun Corps, in giving effect to the instructions laid down in the Official Text Book on Machine Guns, and are corrected up to date.

The continued popularity of this little Handbook necessitates the issue of an Eleventh Edition.

*January, 1917.*

J. B.

## ESSENTIALS FOR MACHINE GUN INSTRUCTORS.

### 1. Study of Official Text Books.

This is the first essential for all machine gun instructors, as therein is contained a full and detailed description of the various machine guns in use, and constitute the authority for the contents of this Handbook.

It is hoped that these Notes may be of some assistance to instructors. Having first studied the official books to see What to Teach, a perusal of these Notes will help instructors How to Teach, and also stimulate interest in this branch of training.

### 2. Qualities of Machine Gun Instructors.

Non-Commissioned Officers taking up the duties of a machine gun instructor should impress upon the men the importance and responsibility of being a machine gunner. They should also strive, by personal example, to set forth the good points which go to make the ideal gunner.

These points are as follows :—

- (a) Enthusiasm for machine gunnery.
- (b) Cheerful temperament.
- (c) Good physique.
- (d) Will power and determination.
- (e) Mechanical turn of mind.
- (f) Initiative and resource.

Enthusiasm is contagious. When the instructor is enthusiastic those under instruction soon learn their work. A cheerful temperament is especially necessary, because there is much hard work to be done in a Machine Gun Company, by night as well as by day. A mechanical turn of mind is not acquired easily. Some may possess no mechanical ability on joining the Company, but constant study of the working parts of the various guns and frequent handling will establish the requisite knowledge and confidence.

The other qualities speak for themselves.

### 3. Manner.

The first point an instructor should study, when imparting instruction, is his manner. He requires great patience, and should cultivate a *quiet, convincing manner*. To do this he must have a thorough knowledge of his work, making sure that he can explain the reason for everything he strives to teach. He must be insistent without bullying, above all things avoid sarcasm and slang terms, and encourage men to ask questions. In a similar manner the men's temperaments differ, and need careful study by the instructor.

### 4. Application of Instruction.

In the elementary work those under instruction should be assembled in a semi-circle around the gun, seated as convenient. The

instructor explains carefully and concisely each point dealt with during the lesson, drawing each man's attention by touching or moving the gun parts as required.

Demonstration of some part of the work by the instructor, or by one of the gunners, will often revive interest which is on the wane owing to long explanations.

Each stage must be thoroughly understood before proceeding to the next. Frequent interrogation will show when the instructor should go on.

### 5. Gunners to "handle" the Gun Parts.

Even in the early lessons the gunners should be given frequent practice in removing and replacing the lock, feed block, fusee spring box, etc. This gives confidence and facilitates quickness in handling the gun. This facility is only gained by constant practice. Therefore it is suggested that at every lesson on Description or Mechanism each gunner should be ordered to remove and replace several parts of the gun, or to weigh and adjust the fusee spring, under the eye of the instructor. By this means correct methods will be inculcated and damage to gun parts prevented.

### 6. Instructional Kit.

When teaching Mechanism, Stoppages, Drill, etc., it is most important that the instructor has on parade a number of dummy cartridges, prepared dummies, separated cart-

ridge cases, a brass lock, clearing plug, spare lock and feed block, also all the necessary appliances to correctly illustrate points arising during instruction.

### 7. The Value of Personal Effort.

The most successful instructors are those who are able to induce men to eradicate their own faults by personal effort. This is the principle of standardising elementary machine gun training. The men are shown how to mount the gun, tap automatically, etc., on the parade ground or in the drill hall, and also told the standard of efficiency they are expected to reach, then encouraged by personal interest and effort to attain the necessary standard during leisure hours.

This is the best form of teaching and should always be employed.

### 8. Night Work.

Attention is drawn to this subject because of its increasing importance. A considerable amount of training is required before gunners are able to quickly bring the gun into action; to clear stoppages, or effect repairs, during hours of darkness. Instruction should therefore be given in these subjects when possible at night.

### 9. Quick Training.

When time is pressing it is suggested that the teaching of the detailed action of the mechanism may be curtailed, just sufficient

time being devoted to this subject to ensure that the gunner has a working knowledge of the mechanism of the gun, and energy chiefly concentrated on training each man :—

- (a) To clean and prepare his gun for firing.
- (b) How to fire and what to fire at.
- (c) How to perform the correct "Immediate Action."
- (d) Belt filling.
- (e) Stripping and Repairs.
- (f) Digging and use of ground.

### GENERAL PRINCIPLES OF TRAINING.

The principles on which all training must be based are contained in Field Service Regulations, Part I.

To obtain the best results from machine guns it is necessary that the personnel should be highly trained.

In selecting men for machine gun work great attention should be paid to intelligence, education, and physique.

Running or crawling from position to position, carrying a machine gun or tripod, is most exhausting work.

Therefore physical strength and staying power generally are of the utmost importance.

A mechanical turn of mind is also of great value.

Officers and non-commissioned officers must have a thorough knowledge of the mechanical, theoretical and tactical side of their work.

The men must be experts in the mechanical and practical side of their training.

To obtain the standard required, the machine gun officer, non-commissioned officer or man must be a specialist; he should seldom be required to perform any duty that is not immediately connected with his work as a machine gunner.

If this is not borne in mind good results cannot be obtained from machine guns.

The general principle of training to be observed is that every machine gunner must be trained in such a manner that he can take the place of any member of the team.

The training of the machine gunner is divided into :—

1. Physical training.
2. Mechanical training.
3. Practical training.

In the earlier stages, every man should be exercised in the Physical Exercises as laid down in the Manual of Physical Training and should be practised out of doors in marching, running, and surmounting obstacles.

In the later stages, physical training will consist of :—

Drill with the gun, including running and crawling with the gun over all kinds of

ground, and mounting it in all manner of positions. Men should also be exercised in carrying guns and tripods for long distances.

Some of the above should be practised every day.

The mechanical training, which may be carried out in the neighbourhood of barracks, will consist of :—

Instruction in the mechanism of the gun.

Stripping and repairs.

Care and cleaning.

Points to be attended to before, during and after firing.

“ Immediate action.”

Belt filling by hand and machine.

Familiarity with contents of spare parts, boxes, cases and wallets.

Packing of barrels.

Causes of stoppages.

Practical training in its early stage may be carried out in the vicinity of barracks in conjunction with mechanical training. As soon as the men are thoroughly conversant with the mechanical side of their work, and have qualified in the tests of elementary training, their further practical training will be carried out, as far as possible, in open country away from barracks.

This practical training consists of :—

Drill, elementary and advanced.

Practical knowledge and application of the various duties of machine gunners.

Machine gun signals.

Visual training.

Judging distance.

Construction of range cards.

Indication and recognition.

Aiming off for wind.

Obedience to and passing of fire orders.

Construction of machine gun field works.

Packing limbers.

Firing on the range.

Use of ground and cover.

The methods of indication and recognition, and fire orders, taught in peace, have been found of great value during war.

It has been found that training in these subjects is of value for the purpose of indicating targets and giving fire orders.

In addition, they quicken the gunner's intelligence, powers of observation, and eye for ground.

They impress upon him the fact that **it is his duty to make certain** that all orders passed down are received and understood by those for whom they are intended.

A thorough training in fire orders forms a basis on which to build up any other method of control that may be found necessary in any particular circumstances.

## ORGANIZATION OF MACHINE GUNS.

1. A machine gun squadron consists of :—

Headquarters.

6 sections, each consisting of 2 machine guns.

2. A machine gun company consists of :—

Headquarters.

4 sections, each consisting of 4 machine guns.

3. A motor machine gun battery consists of :—

Headquarters.

3 sections, each consisting of 2 machine guns.

Details regarding machine gun squadrons, companies and batteries are given in the Field Service Manuals and War Establishments.

A machine gun squadron is commanded by a major or captain. Each section is commanded by a subaltern, with a sergeant as second in command.

A machine gun company is commanded by a major or captain, with a captain or subaltern as second in command. Each section is divided into two sub-sections, each commanded by a subaltern with one sergeant as second in command. The senior subaltern commands the section.

A motor machine gun battery is com-

manded by a major or captain. Each section is commanded by a subaltern with a sergeant as second in command.

## VICKERS GUN.

### General Description.

#### Method of Imparting Instruction.

General description should be brief, the main idea being to show the principles on which the gun works, before going into the detailed action of mechanism.

It is a waste of time and energy to teach the *names* of the parts only. These will be referred to so often during subsequent instruction, that they gradually take root in the brain of the beginner. It is also useless to talk too much about parts of the gun which cannot be seen at the moment. Such parts are dealt with when the gun is stripped.

#### System of Instruction.

*Name.*—Vickers Light Machine Gun, '303 inch.

*Weight.*—28½ lbs., including muzzle attachment. 38½ lbs., with barrel casing full of water.

(Guns of recent manufacture are a few pounds heavier, owing to slight alterations.)

#### The Gun is Worked by Two Forces:—

1. The force of explosion.
2. The fusee spring.

#### The Gun is Divided into Two Portions:—

1. The recoiling portion.
2. The non-recoiling portion.

*Note.*—The non-recoiling portion, being easy to see and to understand, will be explained first.

#### Non-Recoiling Portion.

The *non-recoiling* portion consists of:—

1. The barrel casing.
2. The breech casing.

Remove the recoiling portions to prevent confusion while explaining the non-recoiling portion in detail.

#### The Barrel Casing.

(a) Explain its use, and why corrugated. Show the openings and plugs.

(b) Discuss the water supply.

(c) How applied and retained in the barrel casing.

(d) The steam tube, steam escape hole, and condenser.

(e) Rate of evaporation and orders for replenishing water.

(f) Foresight. Pattern and method of adjustment laterally; also how protected from damage.

(g) Remove the muzzle attachment and briefly explain the parts.

The interior of the barrel casing should be explained when the gun is stripped.

**The Breech Casing.**

*This consists of :*

1. Two side plates.
2. Bottom plate.
3. Two covers, front and rear.
4. Rear cross piece.

Explain briefly the function of each part in the following order :

**Outside of Breech Casing.***Right Side Plate.*

1. The check lever. Demonstrate its use.
2. Roller and slide.

*Left Side Plate.*

1. Front cover catch.
2. The studs which hold front end of fusee spring box.
3. The elevating stop.
4. Slide and stud for fusee spring box.
5. Fusee spring. How connected to the recoiling portion, and method of adjustment. Use of the vice pin, etc.

*Bottom Plate.*

1. Sliding shutter. Its object. When to be open and when closed, etc.
2. Elevating bracket. Show connection with mounting and method of securing by means of feather way.

3. Cross head bracket. Show method connecting cross head joint pin.

4. Seating for ejection. Invert gun and show ejection of empty case.

*Rear Cross Piece.*

1. Handles, use of. How filled with oil. Emphasise necessity of screwing up tight, and keeping full of oil.

2. The safety catch. Show automatic action.

3. Thumb piece, firing lever, and pawl.

4. Trigger bar lever. Show connection with pawl and trigger bar.

5. T-shaped screw. Remove and explain its uses.

6. Show how rear cross piece is hinged to outside plates.

*Front Cover.*

1. Explain working of the catch.

2. Open cover and show the extractor stop.

3. Point out the hinge pin securing front and rear covers.

*Rear Cover.*

1. Cover lock and spring.

2. Tangent sight stem, how actuated by piston and spring.

3. Plate and graduations.

4. Slide and how adjusted.
5. Battle sight. Its use and advantages explained.
6. Column on which the stem rests when down.

### **Inside of Breech Casing.**

#### Rear Cover.

1. Show how rigidity is secured by rear cover and rear cross piece grooves.
2. Trigger bar. Show action of spring, and point out the recess for the trigger, and also the projection by which connection is secured with the trigger bar lever.
3. Lock guides. Show use with lock.
4. Ramps. Show use with lock.

### **The Side Plates.**

1. Cams. Show with lock how these control extractor.
2. Cam steps. Explain and demonstrate uses.
3. Rests which support the recoiling portion.
4. The barrel way, or sleeve, through which the barrel passes into the barrel casing.

### **The Feed Block.**

1. Its use, and how fitted and secured in the gun.
2. Levers. Explain action, and show stud connection with recoiling portions.

3. Slide and top pawls. Show spring and finger pieces.
4. Bottom pawls. Explain use, and show spring and finger piece.
5. The cartridge way, with guides. Show use of guides with a dummy cartridge.
6. Cartridge and bullet stops. Show use of these with belt and dummies.

*Note.*—It is convenient to explain the use of ammunition belts at this period of the instruction.

### **Ammunition Belts.**

1. Explain how gun is fed.
2. Use of projecting strips.
3. Show thick edge near bullets to keep cartridges parallel.
4. How packed in box. Filling explained later.
5. Metal and web belts compared.  
(See method of feeding the gun on Plate III page 37.)

### **RECOILING PORTION.**

The recoiling portion consists of :

1. The barrel.
2. Two side plates.
3. The lock.
4. The crank.

### The Barrel.

Use the spare barrel during description.

1. Show the groove near muzzle. Explain its use. Emphasising the correct method of attaching the muzzle cup, and degree of tightness required.
2. The cannellure near breech end. Its use and importance, correct packing.
3. The barrel block and trunnions.
4. Correct method of inserting barrel after repacking, etc.
5. Chamber, bore, rifling, and calibre.

NOTE.—Explain importance of safeguarding both inside and outside of barrel from rust.

### The Side Plates.

1. Remove and show connection with barrel.
2. Show left side plate prolongation and its connection with the feed block.
3. Side plate springs. Explain action.
4. Guides for lock flanges. Explain reason for the interruptions.
5. Crank bearings. Show how these support recoiling portions and move in the slots in breech casing.

### The Crank.

The principal parts of the crank are best shown by removing the side plates.

1. The connecting rod. Show how lock is secured by the interrupted flange.
2. The adjusting nut. Briefly explain object.
3. Show how the crank pin connects the rod to the crank.
4. The crank shaft. Show fitting of crank handle and fusee.
5. Explain briefly various uses of crank handle—e.g., loading, unloading, indicator during stoppages, weighing fusee spring, curved tail, etc.

### The Lock—Outside.

1. Show connection to crank by interruptions inside side lever head.
2. Trace the side levers from the side lever head, and show :—
3. How the upward movement of the extractor is imparted by the side and extractor levers.
4. Show how the upward and downward movements of the extractor are regulated by guide ribs and stops.
5. Explain the parts of the extractor, commencing with the horns and working downwards. Demonstrate, when necessary, with a good dummy cartridge.
6. Show the lock flanges, and explain the interrupted portions.

**Inside the Lock.**

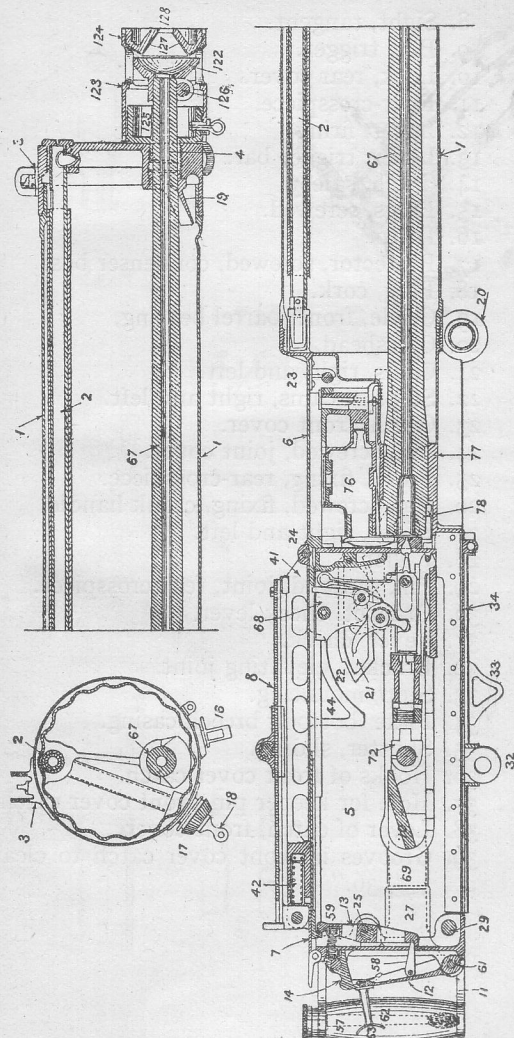
Strip the lock, and lay out the parts on a bench in correct relationship, while explaining.

1. Show the sear, with tail, bent, spring, and claw.
2. Firing pin. With bent, tumbler head recess. Axis bush recess, and lock spring projection.
3. The tumbler. With tail, axis pin, bent, and head.
4. The trigger. With its nose fitting bent of tumbler, axis pin, and tail.
5. Lockspring. Show position of long and short arms, also piece riveted inside lock which acts as a guide for the lock spring when assembling.
6. Show back of the extractor, and position of stops.

**•303-inch Vickers Gun.***Explanation of Plates.*

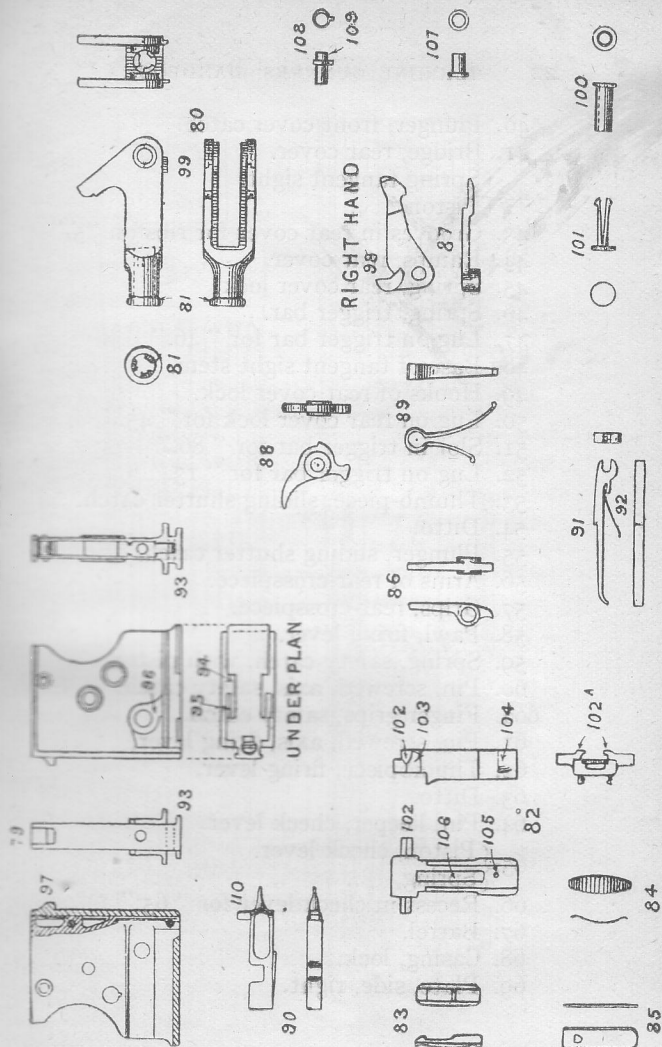
Similar numbers indicate corresponding parts in all the plates.

1. Casing, barrel.
2. Tube, steam.
3. Bracket, foresight.
4. Gland.
5. Casing, breech.
6. Cover, front.
7. Cover, rear.

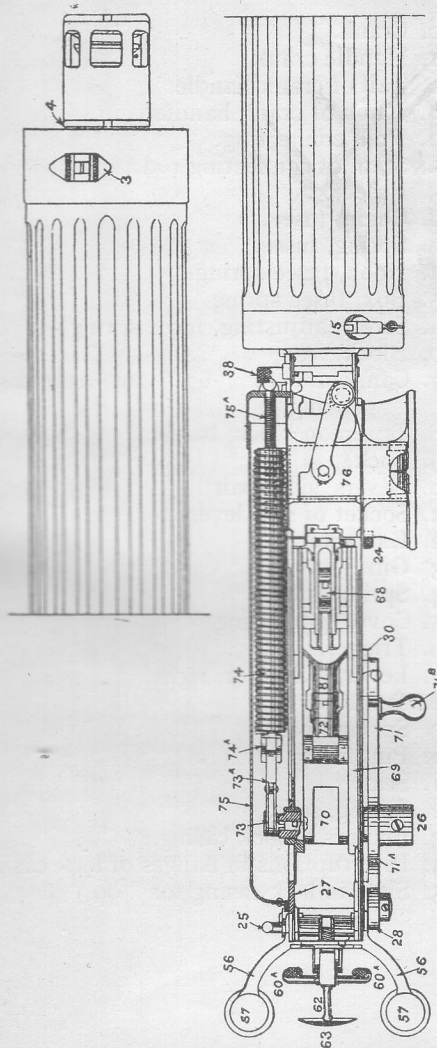


8. Sight, tangent.
9. Bar, trigger.
10. Lock, rear cover.
11. Rear-crosspiece.
12. Lever, firing.
13. Lever, trigger bar.
14. Catch, safety.
15. Plugs, screwed.
16. Ditto.
17. Protector, screwed, condenser boss.
18. Plug, cork.
19. Guide, front, barrel bearing.
20. Crosshead.
21. Cams, right and left.
22. Steps of cams, right and left.
23. Catch, front cover.
24. Pin, screwed, joint cover.
25. Pin-T, fixing, rear-crosspiece.
26. Pin, screwed, fixing, crank handle.
27. Slides, right and left.
28. Roller.
29. Pin, screwed, joint, rear-crosspiece.
30. Bracket, check lever.
31. Lever, check.
32. Bracket, elevating joint.
33. Stop, mounting.
34. Plate, bottom, breech casing.
35. Shutter, sliding.
36. Hooks of front cover catch.
37. Hole for keeper pin, front cover catch.
38. Lever of catch, front cover.
39. Grooves in front cover catch to clear "36."

## THE LOCK.

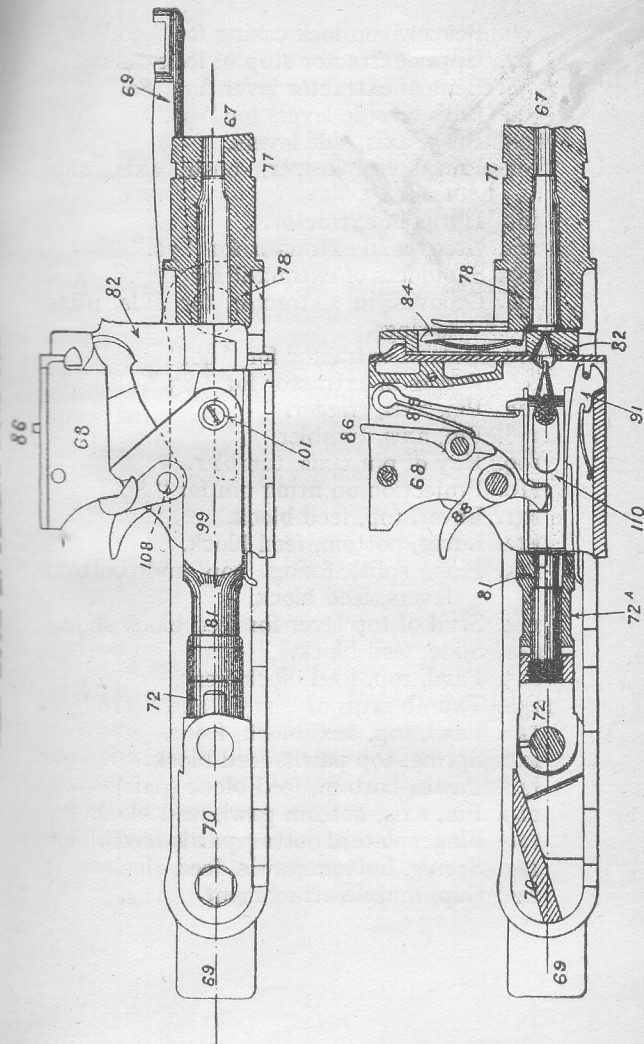


40. Plunger, front cover catch.
41. Bridge, rear cover.
42. { Spring tangent sight.  
Piston " "
43. Grooves in rear cover for ribs on "5."
44. Ramps, rear cover.
45. Spring, rear cover lock.
46. Spring, trigger bar.
47. Lug on trigger bar for "46."
48. Base of tangent sight stem.
49. Hooks of rear cover lock.
50. Lug on rear cover lock for "45."
51. Slot in trigger bar for "86."
52. Lug on trigger bar for "13."
53. Thumb-piece, sliding shutter catch.
54. Ditto.
55. Plunger, sliding shutter catch.
56. Arms of rear-crosspiece.
57. Grips, rear-crosspiece.
58. Pawl, firing lever.
59. Spring, safety catch, with piston.
60. Pin, screwed, axis, safety catch.
- 60a. Finger grips, safety catch.
61. Pin, screwed, axis, firing lever.
62. Thumbpiece, firing lever.
63. Ditto.
64. Pin, keeper, check lever.
65. { Piston, check lever.  
Spring, " "
66. Recess in check lever for "65."
67. Barrel.
68. Casing, lock.
69. Plate, side, right.



- 70. Crank.
- 71. Handle crank.
- 71a. Tail of crank handle.
- 71b. Knob of crank handle.
- 72. Rod, connecting.
- 72a. Stem of connecting rod.
- 73. Fusee.
- 73a. Chain, fusee.
- 74. Spring, fusee.
- 74a. Hook, fusee spring.
- 75. Box, fusee spring.
- 75a. Screw, adjusting, fusee spring.
- 76. Block, feed.
- 77. Cannelure in "67" for asbestos packing.
- 78. Trunnion block, barrel.
- 79. Lock.
- 80. Levers, side (pair).
- 81. Socket of side levers for "72a."
- 82. Extractor.
- 83. Gib.
- 84. Spring, gib.
- 85. Cover, gib spring.
- 86. Trigger.
- 87. Lever, extractor, right.
- 88. Tumbler.
- 89. Spring, lock.
- 90. Pin, firing.
- 91. Sear.
- 92. Spring, sear.
- 93. Flanges of lock casing.
- 94. Interruptions in flanges of lock casing.
- 95. Slots in lock casing for "99."

THE LOCK IN FIRING POSITION.



- 96. Bearings on lock casing for "90."
- 97. Upper extractor stop of lock casing.
- 98. Bent of extractor lever for "80."
- 99. Lugs on side levers for "95."
- 100. Bush, axis, side levers.
- 101. Pin, split, keeper, bush, axis, side levers.
- 102. Horns of extractor.
- 102a. Grooves in extractor for "79."
- 103. Shoulders of extractor for "87."
- 104. Grooves in extractor for side plate springs.
- 105. Hole in extractor for "90."
- 106. Recess in extractor for "83."
- 107. Pin, axis, trigger.
- 108. Pin, axis, tumbler.
- 109. Key of pin, axis, tumbler.
- 110. Projection on firing pin for "89."
- 111. Lever, top, feed block.
- 112. Lever, bottom, feed block.
- 113. Pins, split, fixing, top and bottom levers, feed block.
- 114. Stud of top lever for feed block slide.
- 114a. Slide, feed block.
- 115. Pawl, top, feed block, rear.
- 115a. Thumb grips of "115" and "116."
- 116. Pawl, top, feed block, front.
- 117. Spring, top pawls, feed block.
- 118. Pawls, bottom, feed block (pair).
- 119. Pin, axis, bottom pawl, feed block.
- 120. Finger plate of bottom pawls, feed block.
- 121. Spring, bottom pawls, feed block.
- 122. Cup, muzzle attachment.

- 123. Casing, outer, muzzle attachment.
- 124. Cone, front, muzzle attachment.
- 125. Gland, muzzle attachment.
- 126. Screw, clamping, cup, muzzle attachment.
- 127. Disc, muzzle attachment.
- 128. Vent, bullet, muzzle attachment.

### Action of the Mechanism.

*Note.*—(i) A belt and dummy cartridges will invariably be used for purposes of instruction. (ii) A service lock must always be in the gun, when firing either ball or blank ammunition. For instructional purposes when ammunition is not being fired the D.P. (instructional) lock should be used in the gun whenever possible.

*To Load the Gun.*—(a) Pass the tag end of the belt through the feed block from the right side; (b) with the right hand pull the crank handle on to the roller; (c) with the left hand pull the belt through to the left front as far as it will go; (d) let go the crank handle. The first cartridge will then be gripped by the extractor. Repeat the above, and, when this has been done, the first cartridge will be in the chamber, and another gripped by the upper part of the extractor. The gun is then ready for firing.

On raising the safety catch and pressing the thumb piece of the firing lever the gun will fire automatically until pressure is

released. The lock will then be home, and the extractor will be gripping (a) a live cartridge in the feed block, and (b) a live cartridge in the chamber.

### **Effect of the Force of the Explosion of the Charge and of the Fusee Spring.**

Suppose the gun to have just fired the first cartridge in the belt; the extractor will be gripping the second live cartridge in the feed block and the empty case, which has just been fired, in the chamber; the explosion will cause the recoiling portion to move backwards through a distance of about one inch, thereby extending the fusee spring.

This backward movement is due partly to recoil and partly to the effect of the ball-firing attachment which acts as follows—The powder gases which escape from the muzzle after the exit of the bullet strike violently against the front cone, and rebound on to the front face of the muzzle cup, driving it and the barrel, to which it is attached, backwards. The gases then escape into the air through the openings in the outer casing.

*First Action in the Feed Block.*—The recess in the prolongation of the left side plate by means of the stud actuates the bottom lever of the feed block. The bottom lever acts on the top lever, which moves the slide and the top pawls to the right, to engage behind the cartridge held in place by the bottom pawls.

*Backward Rotation of the Crank.*—The backward movement of recoil causes the tail of the crank handle to roll against the roller, thereby rotating the crank. The rotation of the crank draws back the lock and causes the fusee to wind the fusee chain, thus further extending the fusee spring. The continued rolling of the crank handle against the roller assisted by the fusee spring forces the whole of the recoiling portions forward again, with the exception of the lock, which continues its backward movement for a short distance before it joins in the forward movement.

*Second Action in the Feed Block.*—As the recoiling portions go forward, the recess in the prolongation of the left side plate actuates the bottom lever of the feed block. This bottom lever acts on the top lever, which moves the slide and the top pawls to the left, the pawls thus bringing the third cartridge in the belt to a position against the cartridge and bullet stops, ready to be gripped by the extractor. The belt, as it moves to the left, slides over the bottom pawls, which are depressed as the cartridge passes over them, and rise behind the fourth cartridge, holding the belt in position and preventing it from sliding back after the second cartridge has been withdrawn by the extractor.

*The Lock.*—As the lock moves backwards the extractor withdraws the empty case

from the chamber and a live cartridge from the belt in the feed block. The horns of the extractor move along the upper surface of the solid cams until the cartridge is clear of the belt. When the extractor arrives at the rear end of the cams it is forced down by the ramps in the cover, thus bringing the cartridge drawn from the feed block in line with the chamber, and causing the empty case drawn from the chamber to fall off the extractor. The live cartridge is prevented from slipping down the face of the extractor by the bottom projection of the gib. (If the empty case does not fall off when the extractor drops, it will be forced off by the seating for ejection on the bottom of the barrel casing when the extractor rises.)

*Cocking Action.*—The rotation of the crank gives an upward motion to the connecting rod and side lever head, which latter, bearing on the tail of the tumbler, rotates it on its axis, and thus forces the firing pin to the rear. The long arm of the lock spring acts on the projection of the firing pin, while the short arm bears against the nose of the trigger; consequently the withdrawal of the firing pin compresses the lock spring by drawing the long arm towards the short arm. As the tumbler rotates, the nose of the trigger is forced by the short arm of the lock spring under the bent of the tumbler, and the continued motion of the tumbler forces the firing pin still further back, until the bent of

the sear (which is actuated by the sear spring) is forced into the bent of the firing pin and retains it. The firing pin is thus prevented from flying forward.

*Action of the Fusee Spring.*—When the force of the explosion is expended, the action of the fusee spring comes into play, continuing the forward movement of the barrel and side plates, and unwinding the fusee chain from the fusee. This gives the crank a rotary motion, which forces the connecting rod and side lever head downwards, causing the lock to continue the forward movement and place the live round in the chamber. The extractor is moved upwards by the side levers acting on the extractor levers. The bottom projection of the gib slides over the base of the live cartridge in the chamber and the top projection of the gib slides over the base of the cartridge which has been automatically moved up into position in the feed block. The firing pin hole is thus brought opposite the cap.

As soon as the extractor reaches its highest position, the side plate springs engage in grooves in its sides to prevent the horns falling below and fouling the front end of the solid cams in the breech casing at the commencement of the backward movement, when (a) the side levers are released from the extractor levers (b) the side or extractor levers are worn. This, however, can only

occur when there are no cartridges on the face of the extractor.

The further downward movement of the connecting rod and side lever head causes the lock to be forced slightly further forward, and the breech is then closed. During this movement steps on the side levers travel over bents on the extractor levers.

*Firing Action.*—(a) For the first shot. As the side lever head is brought slightly below the horizontal, it depresses the sear, thereby disengaging it from the firing pin, which then moves slightly forward until the bent of the tumbler engages the nose of the trigger. If the safety catch is raised and the thumb piece on the firing lever pressed, the pawl near the bottom of the firing lever pushes forward the bottom of the trigger bar lever. This, being pivoted in the centre, causes the top to come to the rear, engaging a projection on the trigger bar and drawing it to the rear. As the trigger bar is drawn backwards, the front end of the slot engages and draws back with it the tail of the trigger, thereby releasing the tumbler. The long arm of the lock spring then propels the firing pin on to the cap and the cartridge is exploded.

(b) For subsequent shots. The firer, by maintaining pressure on the thumb piece, holds back the trigger bar. Therefore, each time the lock goes forward the front end of the slot holds back the tail of the trigger before the lock is quite home. By this

means the nose of the trigger is prevented from engaging in the bent of the tumbler. When the lock is home, the side lever head depresses the sear, thus permitting the long arm of the lock spring to carry the firing pin on to the cap, and the charge is exploded.

The depression of the sear is so timed that the firing pin cannot be released until the lock is in the firing position.

On releasing the thumb piece, the short arm of the lock spring forces the nose of the trigger under the bent of the tumbler, so that when the sear is depressed the nose of the trigger engages in the bent of the tumbler and the firing pin is unable to go forward.

### Unloading.

*To unload the Gun.*—Pull the crank handle on to the roller twice in succession (without pulling the belt), letting it fly forward to the check lever each time; release the top and bottom pawls and remove the belt from the feed block—then release the lock spring.

### Summarised Sequence of Instruction in the Action of Mechanism.

Having thoroughly studied the detailed action of mechanism, the instructor will find it useful, for teaching purposes, to memorise it briefly as follows:

1. How to load.
2. How to fire.

3. Unloading.
4. Action on recoil.
5. First action in feed block.
6. Backward rotation of the crank.
7. Second action in feed block.
8. Backward movement of the lock.
9. Cocking action.
10. Action of fusee spring.
11. Forward rotation of crank.
12. Firing action for first shot.
13. Rapid fire.
14. Action inside lock on releasing thumb piece.

### **Method of Teaching Action of Mechanism.**

*Demonstration* is the most powerful aid to instruction when teaching mechanism of any kind. Men learn through the eye rather than the ear. Every opportunity should, therefore, be taken to demonstrate while explaining, and show each motion as it would actually take place.

Again, one would emphasise the necessity of *going slowly*. The quick instructor (and especially the one who suddenly produces all the inside parts of the lock with two taps of a hammer) leaves those under instruction bewildered and discouraged, and they return to quarters as men leave a first-class sleight-of-hand entertainment.

#### **1. Loading.**

Pass the tag end of the belt into the feed block from the right side. Now pause to

explain the reasons for each of the motions as they are performed.

(a) Open the rear cover and show that the crank handle must first be pulled on to the roller, for three reasons—viz. :

1. To draw back the lock to allow a free passage for the first cartridge into the feed block.
2. To make the extractor fall so that it will grip the cartridge when the lock goes home.
3. To compress the lock spring.

(b) As you take hold of the belt, emphasise the necessity for pulling *straight* through the feed block as far as it will go.

(c) The crank handle is released to allow the lock to go forward and the extractor to grip the first cartridge in the belt.

(d) Explain that the motions must be repeated in order that the extractor may carry the round from the feed block to the chamber, and a second cartridge to be drawn into the feed block to be gripped as the extractor rises, so ensuring automatic feeding.

#### **2. To Fire the Gun.**

Explain briefly as you demonstrate :

(a) That on raising the safety catch and pressing the thumb piece the gun fires automatically.

(b) On releasing the thumb piece, the gun stops firing, with two live rounds on the face of the extractor.

NOTE.—The details of the above actions should not be explained at this stage.

### 3. Unloading.

(a) Open the rear cover and show what happens to the cartridge each time the crank handle is turned over.

(b) Explain why the bottom pawls must be depressed, before the belt can be withdrawn.

(c) Draw attention to the necessity of always releasing the lock spring after unloading.

### 4. Action on Recoil.

Remove the outer casing of the muzzle attachment, and disconnect the fusee spring box from the studs, so that the box may be held open in the left hand, with the spring connected to the chain. Now cause one of the men under instruction to slowly push back the muzzle, to demonstrate the effect of the explosion upon the recoiling portions, particularly the first extension of the fusee spring.

### 5. First Action in the Feed Block.

Remove the fusee spring box and see that the recoiling portions are fully home. Now direct attention to the slide of the feed block,

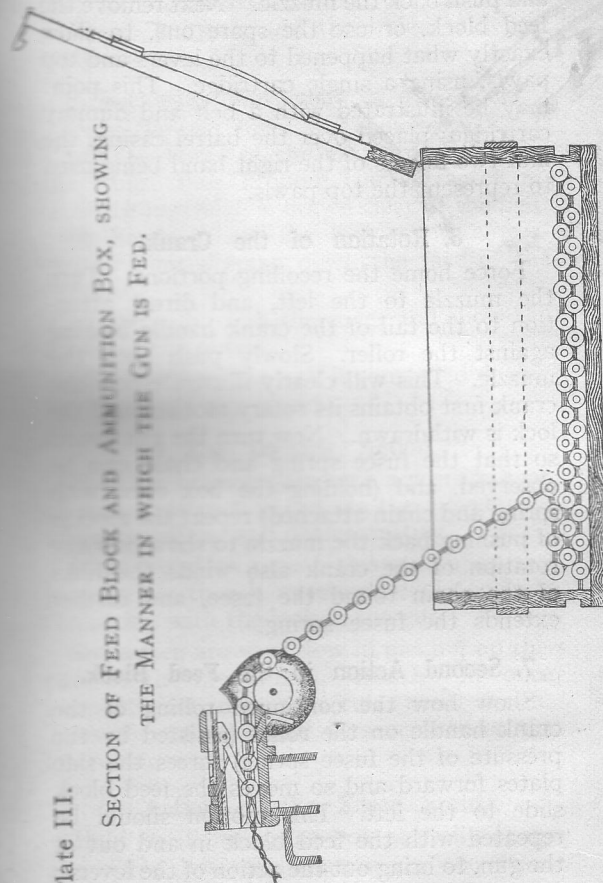


Plate III.

SECTION OF FEED BLOCK AND AMMUNITION BOX, SHOWING  
THE MANNER IN WHICH THE GUN IS FED.

and push back the muzzle. Next remove the feed block, or use the spare one, to show exactly what happened to the levers and top pawls, using a single cartridge. This point may be illustrated with a belt and dummy cartridges placed over the barrel casing, the first two fingers of the right hand being used to represent the top pawls.

### 6. Rotation of the Crank.

Force home the recoiling portions. Turn the muzzle to the left, and direct attention to the tail of the crank handle bearing against the roller. Slowly push back the muzzle. This will clearly illustrate how the crank first obtains its rotary motion, and the lock is withdrawn. Now turn the gun round so that the fusee spring and chain can be observed, and (holding the box open with spring and chain attached) repeat the motion of pushing back the muzzle to show how the rotation of the crank also winds the links of the chain round the fusee, and further extends the fusee spring.

### 7. Second Action in the Feed Block.

Show how the continued rolling of the crank handle on the roller (assisted by the pressure of the fusee spring) forces the side plates forward and so moves the feed block slide to the left. This motion should be repeated with the feed block in and out of the gun, to bring out the action of the levers ;

the top and bottom pawls ; the use of the cartridge guides ; and the bullet and cartridge stops.

### 8. Backward Movement of the Lock.

Open the rear cover and show :

(a) The horns of the extractor riding on the cams, thus keeping the extractor up until the cartridge is drawn clear of the belt.

(b) Explain how the live round is prevented from slipping down the face of the extractor.

(c) Partially close the cover and show the action of the ramps.

(d) Show how the lock is controlled during the backward movement.

### 9. The Cocking Action.

Hold the brass lock in such a position that all under instruction can see the movements while explaining and demonstrating.

It is useful to repeat this action several times, then to ask questions while cocking the action with the lock in the gun.

Some men are very slow in picking up this part of the mechanism. But having once learned, such men, as a rule, never forget. Thus the patience and perseverance of the instructor is rewarded.

### 10. Action of the Fusee Spring.

Hold the fusee spring box partially open, and show how the tension on the fusee

spring carries the crank and plates forward, and also rotates the crank.

### 11. Rotation of Crank.

(a) Replace the fusee spring box. Open the rear cover, and show how the rotation of the crank causes the lock to continue its forward movement, placing the live round in the chamber. Explain what becomes of the empty case.

(b) Show how the extractor is moved upwards by the side levers acting upon the extractor levers. (Use a spare lock to show this action.)

(c) Show with a spare lock and dummy cartridges, how the projections of the gib slide over the base of the cartridges in the chamber and feed block.

(d) Show how the side plate springs engage in the grooves on the outside of the extractor. Show this *without* dummy cartridges, to emphasise that the side plate springs are only useful when there are no cartridges on the face of the extractor.

(e) Show how the steps on the side levers travel over the bents on the extractor levers as the lock is forced farther forward and the breech finally closed.

### 12. Firing Action for First Shot.

With a brass lock show how the crank, on passing below the horizontal, forces the tail of the sear downwards. Explain resulting

action of the lock spring. Draw attention to the fact that now it is only necessary to release the nose of the trigger from the bent of the tumbler to fire the first shot. Illustrate this with the brass lock, pointing out the action of the lock spring. Repeat this action by pressing the thumb piece, bringing out the connections between the firing lever, pawl, trigger bar lever, trigger bar recess, and projection.

### 13. Rapid Fire.

Using the brass lock, explain that single shots are fired by means of the trigger, and rapid fire by means of the sear. Show also that it is the function of the sear to hold back the firing pin until the lock is in the firing position.

It is most important that every gunner should thoroughly understand this "timing" principle of the sear and firing pin, because on taking into use a strange lock, the sear "timing" should be tested by the gunner immediately, and if necessary, adjusted.

### 14. Action Inside the Lock on Releasing the Thumb Piece.

(a) Release pressure from the thumb piece. Explain that the trigger bar has now returned to its original position, and is therefore unable to engage the tail of the trigger as the lock moves forward.

(b) Show with a brass lock the action of the short arm of the lock spring, forcing the

nose of the trigger under the bent of the tumbler.

(c) Demonstrate the action of the side lever head depressing the sear, and the bent of the tumbler immediately engaging the nose of the trigger, so stopping the gun from firing.

### STRIPPING MACHINE GUNS FOR INSTRUCTIONAL PURPOSES.

In the early stages of instruction it is very sound for the instructor to strip a gun so as to more easily explain the automatic working of the various parts.

At further lessons the gunners should be allowed to strip all the parts until thoroughly familiar with them.

Afterwards, the gunner should always be given a definite task, e.g., "Replace the barrel," "Replace a broken firing pin," etc., and in these cases attention should be drawn to the gunner only removing necessary parts.

#### Repairs and Adjustments.

**Stripping the gun.**—The gun is stripped in the following order; the gun being on the mounting.

**1. Lock.**—Clear the extractor by revolving the crank handle twice; raise the rear cover, pull the crank handle on to the roller; place finger between the extractor and stop, lift the

lock, at the same time allowing the crank handle to move *slowly* forward until the lock is released from the side plates. Give the lock one-sixth of a turn in either direction and lift out.

**2. Feed block.**—Release the front cover catch, raise the front cover, and lift out.

**3. Fusee spring box.**—With the right hand at the rear and left hand at the front, press the box forward until clear of the lugs and remove. Disconnect the fusee chain and remove the box and the spring. Care should be taken to throw no cross strain on the chain.

**4. Fusee.**—Turn the fusee to the rear until the lugs on the stem are free to be withdrawn.

**5. Ball firing attachment.**—Withdraw the split pin. Give the outer casing one-sixth turn and remove it. Unscrew the front cone. Loosen the clamping screw of the muzzle cup and revolve the cup till the clamping screw coincides with the flat on the barrel. Remove the muzzle cup. Unscrew and remove the gland.

**6. Slides, right and left.**—Raise the rear cover, unscrew the rear cross piece screwed fixing T-pin, and hinge down the rear cross piece. Pull out the slides.

**7. Recoiling portion.**—Draw the recoiling portion out to the rear. Disconnect the side plates from the barrel, removing the left one first. (For convenience only, the left side

plate is removed first.) If necessary, by taking out the fixing pin, the crank handle can be driven off with a drift and hammer, but as a rule this should not be stripped.

**8. Roller.**—Remove split fixing pin, collar and roller.

**9. Check lever.\***—Drive out keeper pin from underside, and take off check lever. To remove piston and spring, turn the piston by using a screwdriver in the slot until the lugs are free to be withdrawn, when the piston will be forced out by the pressure of the spring.

**10. Tangent sight.\***—Unscrew axis pin and force out. Remove tangent sight, piston and spring.

**11. Cover lock.\***—Unscrew axis pin and force out. Remove cover lock and spring.

**12. Trigger bar.\***—Remove spring and withdraw trigger bar.

**13. Covers, front and rear.\***—Remove keeper pin and check nut; force out joint pin and take off covers.

**14. Front cover catch.\***—To remove spring and plunger, force the plug forward with a screwdriver and give a quarter turn, when the piston will be forced out by the spring. Before removing the plunger, it must be turned so that the slots are free to pass the lugs in the catch.

\*These components are not to be stripped except by armourers, and then only when absolutely necessary.

**15. Rear cross piece.\***—Remove keeper pin and check nut and force out joint pin. Lift out rear cross piece.

**16. Foresight.\***—The position of the foresight should first be carefully marked. Using a drift and hammer, drive the foresight out of its dovetail seating through the opening in the right protecting wing.

**17. Steam tube.\***—Up-end the gun so that it stands on the rear end of the breech casing. Remove the keeper screw and unscrew the steam tube.

**18. Sliding shutter.\***—Press in the catch and force the shutter to the front until it is against the stop, then press in the plunger with a No. 3 punch and force the shutter further to the front until it is free to be withdrawn from the breech casing.

## 19. To strip the lock.

(a) See that the lock is cocked.

(b) Force out the side lever split pin and axis bush.

(c) Remove side levers and extractor levers.

\* These components are not to be stripped except by armourers, and then only when absolutely necessary.

(d) Slide the extractor from the face of the lock casing.

(e) Release the lock spring and push out the trigger and tumbler axis pins.

(f) Remove trigger, tumbler, lock spring, firing pin and sear with spring.

(g) To strip the extractor, push out the gib spring cover and remove spring and gib.

## 20. To Assemble the lock.

(a) Insert the sear.

(b) Insert the firing pin with bent next to the sear.

(c) Replace the tumbler and axis pin.

(d) Replace the trigger and axis pin.

(e) Press back the firing pin and slide on extractor.

(f) Replace extractor levers.

(g) Replace side levers.

(h) Replace bush and split pin.

(j) Rest the lock on a bench (base downwards) and press down the side lever head and tumbler, at the same time holding back the tail of the trigger. This places the inside parts in correct position to receive the lock spring.

(k) Force in the lock spring, the long arm to be nearest the extractor.

## 21. Feed block.\*

(a) Force out the split fixing pin of the top and bottom levers; drive out the bottom lever, and remove the top lever and slide.

(b) Remove top pawls from the slide by pressing them down to clear the lugs, and outwards; remove top pawl spring.

(c) Draw out the axis pin of the bottom pawls and remove the bottom pawl spring and pawls.

## 22. Rear cross piece.\*

(a) Unscrew firing lever axis pin and remove firing lever.

(b) Unscrew safety catch axis pin and remove safety catch, piston, and spring.

(c) Lift out trigger bar lever.

## 23. Tangent sight and spring.

(a) Remove top fixing screw of the graduated plate.

(b) Run the slide off the stem.

(c) Remove the fixing screw of the milled head and lift the latter off the slide.

(d) Remove the fixing pin, pawl, and pinion, from the slide.

(e) Place the milled head, face upwards, on a bench; then, with the small screwdriver applied to the rectangular nib on the slide spring, knock the latter down flush with the face, when it can be lifted out with the pliers.

\*These components are not to be stripped except by armourers, and then only when absolutely necessary.

Before assembling the gun all parts should be tried in their places separately to see that they work freely.

**Assembling the gun.**—Reverse all the foregoing operations with the exception that the recoiling portions must be replaced before the packing and packing gland. When assembling the lock, care must be taken that the lock spring is replaced with the lock in the fired position, and when all the other parts are assembled. When assembling the rear cross piece see that the pawl of the firing lever engages with the trigger bar lever. When assembling the tangent sight, it will be found convenient to place the slide on the stem (axis end) before attaching the milled head; in this position the pinion is prevented from turning with the pawl when engaging the arms of the spring outside the lugs on the pawl.

### Connecting Rod.

*Instructions for fitting washers to connecting rod when required:—*

Take off fusee spring. Raise cover, turn crank handle back and remove lock. Turn the connecting rod back on to trigger bar lever; then with the combination tool unscrew and remove the adjusting nut from connecting rod. Place one of each of Nos. 1 and 2 washers on the shoulder of connecting rod, and screw the adjusting nut tightly home on to the washers.

Place one more of each of Nos. 1 and 2 washers on the outer face of adjusting nut, and test length of connecting rod.

### Instructions for fitting spare discs for the ball-firing attachment.

The disc is placed in the front end of the outer casing and is pressed home and held in position by the front cone. Six spare discs are supplied. When one gets badly eroded it is removed by unscrewing the front cone, on which the disc may be found firmly fixed, cutting the front bevel of the disc across with a chisel and dividing sufficient metal up to provide a hold for the pliers. When assembling a new disc it may be necessary to lightly tap the front cone whilst screwing the disc home.

### Instructions for Packing Barrels.

*To renew the packing at the breech end of the barrel.*—Should the gun leak at the breech, empty the barrel casing. Draw out the recoiling portion. Wind a strand of asbestos (part of a 5 yards piece) in the cannellure of the barrel, pressing it together with a thin piece of wood or the point of a screwdriver or knife, until the cannellure is full, then oil the asbestos and reassemble the parts.

*To renew the packing at the muzzle end of the barrel.*—Should the gun leak at the muzzle, stand the gun on the rear crosspiece, remove the ball-firing attachment, unscrew

the gland and repack, or, if necessary, replace the asbestos, having first oiled it, by winding it loosely round the barrel, and whilst winding push it in with punch No. 2, a piece of wood, or any blunt-ended instrument which will fit; screw on the gland, as tightly as can be done by hand, return the gun to a horizontal position, hang the lock, and work the recoiling portion backwards and forwards to ensure that it moves freely. If the packing is found to press too hard on the barrel, the gland should be removed and one or two strands taken out of the asbestos.

### Examination.

The following are the principal points to be observed in the examination of guns without using gauges:—

*Recoiling portion.*—See this moves freely. Pull not to exceed 4 lbs.

*Foresight.*—See that the blade is in good condition.

*Tangent sight.*—See that the top edge and U on slide are in good condition, and that the slide works correctly.

*Safety catch.*—See the spring and catch act automatically when the firing lever is released.

*Firing lever.*—Test the firing lever by seeing that the trigger bar does not release the trigger before the safety catch is clear, and also see that the trigger is released

before the stop on the lever bears against the stop on the rear crosspiece.

*Connecting rod.*—Test whether correct length with both locks as follows: Take off the fusee spring. Raise the cover, turn the crank handle back and remove the lock. Place one of each of Nos. 1 and 2 washers on the outer face of the adjusting nut on connecting rod. Replace the lock on the connecting rod and let it down into the gun, retaining the lock in its rear position. The extractor being down, insert, through the opening in the underside of the breech casing, the special armourers' machine gun dummy cartridge in the bottom end of the extractor over the firing pin hole. Push the extractor right up to the upper stop, and, still retaining hold of the cartridge, see that the barrel is home; then turn the crank handle over towards the check lever, at the same time guiding the cartridge into the chamber. Push the check lever back just clear of the crank handle and let the crank handle gently down towards rest. If the connecting rod is within limit for length, a check will be felt. If no pressure is required, it shows that the lock is not fully home (*i.e.*, the connecting rod is not long enough, and therefore outside the limit). If within limit, remove the washers. If outside the limit, washers must be fitted permanently to the connecting rod (see page 48).

No. 1 washer is plain. No. 2 washers of

later manufacture have two small holes punched in the rim.

*Barrel.*—See to the condition of bore, rifling, lead and exterior.

*Lock.*—Test the extractor and side levers by bringing the crank handle gently on to the check lever. If the levers are correct, the extractor will be right up. Test the bents of the sear and firing pin. To do this, pull the crank handle on to the roller, then bring the crank handle gently down on to the check lever. The extractor should be well up to the top position before the sear is released. Examine the face of the extractor for burrs and flaws, at the gib gap and firing pin hole. Try the grooves with a dummy cartridge (armourers' dummies must be used for this purpose) to see the gib holds the cartridge horizontally. See that the nose of the trigger and bent of the tumbler are not too much worn. See that the point and bent of the firing pin are in good condition. A broken firing pin can be recognised without stripping the lock by releasing the lock spring with the extractor up. If correct, the firing pin will then protrude from the firing pin hole and can be withdrawn by raising the tail of the tumbler. If it does not protrude, or, if protruding, the point is not withdrawn when the tail of the tumbler is raised, the firing pin is broken.

*General.*—See that all axis pins are correct.

## STOPPAGES.

### Stoppages in the Automatic Action of the Gun During Firing.

Every opportunity should be taken to thoroughly clean guns. On service, where guns have been properly looked after, stoppages, due to faulty mechanism, have been very rare.

The most common troubles have been :—

#### (a) Faults in feed due to—

- (i) Badly filled belts.
- (ii) Wet and dirty belts.
- (iii) Pockets becoming loose.

#### (b) Bulged barrels, due to—

Getting mud into muzzle of gun when mounting, dismounting, or crawling with gun, etc.

Great care should be taken to prevent this.

#### (c) Broken—

- (i) Lock springs, due mainly to leaving spring compressed.

(ii) Muzzle cups, due to their being too tightly screwed up or being too loose.

Stoppages in the automatic action of the gun during firing may be classed under two main headings:

(i) **Temporary**, which are due to—

(a) Failure of some part of the gun, of which a duplicate is carried, and which therefore can be easily and quickly replaced, or faulty ammunition.

(b) Some cause which can generally be avoided by a high standard of training and a thorough knowledge of their gun by the detachment. These are generally due to neglect on the part of the detachment of some of the points to be observed before, during, and after firing.

(ii) **Prolonged**, which are due to failures of some part of the gun which cannot, as a rule, be put right by the detachment under fire or without skilled assistance. These necessarily put the gun out of action for a more or less prolonged period.

On the knowledge and training of the detachment depends the rapidity with which "temporary" stoppages can be overcome. "Prolonged" stoppages, however, require skilled assistance as a rule before they can be

overcome, but a knowledge of their causes and remedies is none the less essential before the detachment can be considered thoroughly efficient.

The table of temporary stoppages, on pages 66-69, set out under five columns, gives a clear indication of the method to be employed in teaching the detachment the practical side of the mechanism. Column I shows the four positions of the crank handle when the gun stops firing. The first three positions may vary slightly, as shown by the dotted lines. These positions, which afford a ready indication of the cause of stoppage—and therefore of the correct "immediate action" to be performed—must be recognized clearly before the instruction proceeds.

At this stage the detachment should not be required to know what these four positions indicate. The indication given below the diagram will be explained when the probable causes of the stoppages are being taught.

Column II gives a detailed description of the "immediate action" to be performed by the firer (sometimes with the assistance of No. 2) as soon as the position of the crank handle has been recognized after the gun has stopped firing.

Column III deals with the probable causes of these stoppages, but it is of first importance

that the instructor does not proceed to this stage until he is assured that every "immediate action" can be correctly and immediately carried out without the slightest hesitation or forethought.

A thorough knowledge of the causes of temporary stoppages will not only give the detachment a practical knowledge of the working of the gun; but will also be a help in the discovery of the cause of any unusual breakdown which may occur.

In Column IV is given the method for preventing the recurrence of certain stoppages, the cause of which may be only temporarily cured by the immediate action. It will sometimes be possible to carry out these preventions in two or three minutes; at other times their execution may cause the gun to be temporarily out of action for a longer period; but, in either case, no skilled assistance or special appliances other than those carried with the machine gun section will be required.

Column V shows how the various temporary stoppages can be simulated for instructional purposes. It is unnecessary to teach these methods of preparation to the machine gunner, but every instructor must have a thorough knowledge of this column in order to teach the correct "immediate action" for any temporary stoppages.

### Method of Instruction.

Whenever instruction is being carried out, a belt and dummy cartridges will be *invariably* used, and in order to simulate the various stoppages, empty cases, bulged dummy cartridges, separated cases, and dummy cartridges with the rims thickened, will be required by the instructor.

The instructor must also see that a spare lock and a clearing plug are by the gun, without which the correct immediate action cannot always be carried out.

As the clearing of a stoppage often knocks the sights off the aiming mark, the instructor should lay stress on the importance of relaying the gun, and for this purpose the instructional machine gun or landscape target will be used.

In addition to the instructions conveyed in the table, the following points should be observed:

(i) When lifting out the lock it should be held with the forefinger under the top extractor stop and the thumb at the back of the lock.

(ii) When a temporary stoppage necessitates the employment of the spare lock, the damaged lock should be repaired as

soon as possible, so as to make it again available as a reserve.

(iii) Should it ever be necessary to release the lock spring with the lock out of the gun, this should be done with the extractor fully up, and the firing pin hole opposite the firing pin.

### Immediate Action.

1. The probable causes of stoppages should never be discussed during immediate action instruction.

The instructor demonstrates the particular immediate action he is about to teach. He should emphasise the necessity for scrupulous accuracy in every detail, and for crisp and clean handling of the gun parts to ensure that no fresh stoppage occurs due to clumsy manipulation on the part of the gunner.

2. The gunner is then told exactly what is required of him immediately he sees the position of the crank handle.

(a) Correct immediate action. (Assisted sometimes by No. 2.)

(b) Gun relayed on mark.

(c) Fire reopened.

Each is of equal importance. The instructor should always check the aim and watch the tendency to simply jerk the thumb piece forward and release it again, when re-opening fire. This is a common fault in immediate action training.

3. The gunner takes up the sitting position behind the gun with head turned aside, while the instructor sets up the required stoppage and taps the gun off the mark. The element of surprise is an essential feature in this part of the training, the instructor therefore covers the crank handle with cap or handkerchief, uncovering it suddenly when the gunner is in the firing position.

4. It is often argued that when the cause of a stoppage is obvious to the gunner, as in the case of a bad fault in feed, it is unnecessary to go through the preceding immediate actions for that particular stoppage. This idea is erroneous, because on service the gun is not always firing with sufficient light to see what is the cause of stoppage. We should therefore train our men to go through all the motions laid down; this will enable them to get the gun firing again by night or by day.

5. When men are proficient in immediate action by day, the remainder of the training should be carried out in darkness.

6. A smart instructor who gives a few minutes' demonstration of the various immediate actions before his squad daily will stimulate interest and rouse the competitive spirit more than is possible by hours of talking.


## VICKERS GUN.

### Stoppages.


For Notes on Method of Instruction in Stoppages see page 57.

### Immediate Action.


FIRST POSITION.

Position of Crank Handle.	Method of Preparation by the Instructor.	Immediate Action performed by the Gunner.
<p>FIRST.</p> 	<p>(1) Perform half the loading motions.            (2) Pull the crank handle slowly back until the horns of the extractor have engaged with the steps on the solid cans.            (3) Pull the belt to the left front and let go the crank handle.            (4) Tap the gun off the mark.</p>	<p>(1) Turn the crank handle on to the roller, pull the belt to the left front, and let go the crank handle.            (2) Relay.            (3) Open fire.</p>
<p>If after firing failure recurs lighten fusee spring by 3 "clicks."</p>		

# Immediate Action—continued.

Position of Crank Handle.	Method of Preparation by the Instructor.	Immediate Action performed by the Gunner.
SECOND.		
	<p>(1) Simulating a damaged cartridge: (a) Bulge the leading dummy cartridge in the belt and load. (b) Tap the gun off the mark.</p> <p>(2) Simulating a separation. (a) Perform half the loading motions. Open the rear cover, withdraw and lift up the lock. (b) Place the front portion of a separated case over the bullet of the cartridge on the extractor. (c) Replace the lock, close the rear cover, pull the belt, let the crank handle go <i>slowly</i> forward. (d) Tap the gun off the mark.</p> <p><i>Note.</i>—When it is desired to make the gunner use the clearing plug. Return the lock very slowly, and draw lock back to see that the neck of the case is left in the chamber.</p>	<p>(1) (a) (i) Force the crank handle to the rear: open the rear cover and examine the cartridge on the face of the case or an un-damaged cartridge with the front portion of a separated case adhering to it, clear the face of the extractor and reload. (ii) Relay. (iii) Open fire. (2) If the front portion of the separated case does not come out on the cartridge, clear the face of the extractor. (i) Replace the lock, keeping the crank handle on the roller. (ii) Take the clearing plug (seeing that the centre pin is back) and insert it into the chamber. Push the pin well home by allowing the lock to go forward. Then, keeping a firm pressure on the crank handle, give the clearing plug a rocking motion; withdraw the lock; lever back the handle of the clearing plug and withdraw it and reload. (iii) Relay. (iv) Open fire.</p>

# Immediate Action—continued.

Position of Crank Handle.	Method of Preparation by the Instructor.	Immediate Action performed by the Gunner.
THIRD.		
	<p>(1) To simulate excessive friction: (a) Perform the correct loading motions, except that when completing the loading the crank handle must be eased back gently until it touches the check lever. (b) Tap gun off mark.</p> <p>(2) Slight cross feed: (a) Perform half the loading motions. Pull the crank handle on to the roller. Open the rear cover; pull a cartridge half way into position in the feed block and hold it there. Let the crank handle go slowly home, then tap it down for firmness and close the cover. (b) Tap gun off mark.</p> <p>(3) Simulating bad fault in feed: (a) Pull out the fourth cartridge in the belt about half inch. (b) Perform half the loading motions.</p>	<p>(1 and 2) (i) Slightly raise the crank handle pull the belt to the left front, let go the crank handle, and then strike it down on the check lever. (ii) Relay and open fire.</p> <p>(3) If (1) fails examine feed block slide; if jammed No. 1 pulls the crank handle on to the roller,* holds it there and unlocks the front cover. No. 2 opens the front cover and with the assistance of No. 1 raises the feed block sufficiently to allow the recoiling portions to go home. He releases the top and bottom pawls from the belt, which he withdraws until the top cartridge is clear of the feed block, and rectifies the belt or cartridges if</p>

*Note.*\*—In order to do this, it may sometimes be necessary for No. 2 to open the front cover and force down the horns of the extractor.


# Immediate Action—continued.

## THIRD POSITION—continued.

Position of Crank Handle.	Method of Preparation by the Instructor.	Immediate action performed by the Gunner.
	<p>(c) Pull the crank handle slowly back until the horns of the extractor have engaged with the steps on the solid cam.</p> <p>(d) Draw the recoiling portions to the rear by forcing the knob of the crank handle forward, and tail to the rear at the same time pulling the belt to the left.</p> <p>(e) Allow the recoiling portions to go forward. Bring the crank handle on to the roller and let go.</p> <p>(f) Tap gun off mark.</p> <p>(4) Simulating damaged cartridge grooves etc.:</p> <p>(a) Damage the rim of the second dummy cartridge in the belt.</p> <p>(b) Proceed to load.</p> <p>(c) Tap gun off mark.</p> <p>Note.—As damage to the extractor has to be simulated by damaging a cartridge rim, this cartridge must be removed before reloading.</p>	<p>necessary. He replaces the feed block, pushing the slide over to the left, and lowers the front cover. No. 1 locks the front cover, pulls the belt to the left front and releases the crank handle.</p> <p>(ii) Relays.</p> <p>(iii) Opens fire.</p> <p>(4) (i) If the slide is free, No. 2 opens the front cover and forces the extractor down, while, <i>at the same time</i>, No. 1 pulls the crank handle on to the roller. No. 1 lifts up, clears, changes the lock, No. 2 removes the cartridge in position in the feed block, and No. 1 reloads.</p> <p>(ii) Relays.</p> <p>(iii) Opens fire.</p>

# Immediate Action—continued.

## FOURTH POSITION.

Position of Crank Handle.	Method of Preparation by the Instructor.	Immediate Action performed by the Gunner.
<p>FOURTH.</p> 	<p>(1) To simulate a miss fire:</p> <p>(a) Load and press the thumb piece.</p> <p>(b) Tap gun off mark.</p> <p>(2) To simulate a broken firing pin: call out, "Gun will not fire," as soon as the gunner completes his first "Immediate action."</p>	<p>(1) (i) Turn the crank handle on to the roller, pull the belt to the left front and let go the crank handle.</p> <p>(ii) Relay.</p> <p>(iii) Open fire.</p> <p>(2) If gun fails to fire, place crank handle on to the roller twice, change the lock and reload.</p> <p>(ii) Relay.</p> <p>(iii) Open fire.</p>

# STOPPAGES.

## VICKERS LIGHT MACHINE GUN.

Position of crank handle and its indication.	Immediate Action.	Probable Cause.	Prevention of Recurrence.	Method of preparation for Instructional Purposes.
I. Indication. The lock is unable to come back far enough to allow the extractor to drop.	(i) Turn the crank handle on to the roller, pull the belt to the crank handle. (ii) If after firing failure recurs, lighten fuse spring by 3 "clicks."	The extractor has not dropped. This may be due to: (a) Excessive friction, due to want of oil, grit, or tight pockets in the belt, or excessive packing in the cannelure or packing gland. (b) Too heavy fuse spring. (c) Partial loss of the force of the explosion due to: (i) Worn barrel. (ii) Defective ammunition.	(a) Clean and oil working parts. Examine the belt, which should be dried, if damp, or if the stoppage is due to a new or stiff belt the pockets should be plugged. If due to excessive packing, examine, and repack cannelure or packing gland. (c) The barrel should be examined at the first opportunity, and, if much worn in the lead, should be changed.	Perform half the loading motions; pull the crank handle slowly back until the horns of the extractor have engaged with the steps on the solid crans; pull the belt to the left front, and let go the crank handle. For range purposes: Increase the weight of the fuse spring.
II. Indication. The lock is unable to go fully home after recoil.	(i) Force the crank handle to the rear: open the rear cover and examine the cartridge on the face of the extractor. If a damaged cartridge or an undamaged cartridge with the front portion of separated case adhering to it, clear the face of the ex-	(a) Damaged cartridge. The cartridge is unable to enter the chamber completely although it has commenced to do so. (b) Separated case. The front portion of the case causes an obstruction and prevents the next cartridge	(a) Bulge the leading dummy cartridge in the belt and load. For range purposes: Place a bulged dummy cartridge in the belt. (b) Perform half the loading motions. Open the rear cover, withdraw and lift up the lock. Place the front	



III.  
Indication.  
The extractor is unable to rise to its highest position, though the lock is almost home.  
If the feed block slide is jammed there is a fault in feeding and the porting are not quite home.

From going into the chamber; bang through.

(i) If the front portion of the separated case does not come out on the cartridge, clear the face of the extractor, replace the lock, keeping the crank handle on the roller. Take the clearing plug (seeing that the centre pin is back), and insert it into the chamber. Push the pin well home by allowing the lock to go forward. Then, keeping a firm pressure on the crank handle, give the clearing plug a rocking motion; withdraw the lock; lever back the handle of the clearing plug and withdraw it and reload.

(a) Excessive friction.

(a) Clean and oil working parts.

(b) A cartridge is fed up slightly crossways or a long brass strip is bent.

(b) Carefully examine the belt.

portion of a separated case over the bullet of the cartridge on the extractor. Replace the lock, close the rear cover, pull the belt, let the crank handle go slowly forward.

For range purposes: File a cartridge about one inch from the base and insert in the belt.

Care must be taken that the cartridge is not filed too far through as there is the danger of the bullet being left in the barrel.

67

(a) Perform the correct loading motions, except that when completing the loading the crank handle must be eased back gently until it touches the check lever.



For range purposes:

Lighten the fuse spring.  
(b) Perform half the loading motions. Pull the crank handle on to the roller. Open the rear cover; pull a cartridge half way into position in the feed block and hold it there. Let go the crank handle and close the cover.

For range purposes:

Bend a long brass strip.

# STOPPAGES—VICKERS LIGHT MACHINE GUN—continued.

Position of crank handle and its indication.	Immediate Action.	Probable Cause.	Prevention of Recurrence.	Method of preparation for Instructional Purposes.
<p>III.</p> 	<p>(ii) If (i) fails, examine feed block slide; if jammed No. 1 pulls the crank handle on to the roller, holds it there and unlocks the front cover. No. 2 opens the front cover and with the assistance of No. 1 raises the feed block sufficiently to allow the recoiling portions to go home. He releases the top and bottom pawls from the belt, which he withdraws until the top pawl is clear of the feed block and certifies the belt on rollers if necessary. He replaces the feed block, pushing the slide over to the left. No. 1 looks the front cover, pulls the belt to the left, front and back to the left front and releases the crank handle.</p>	<p>(ii) (a) Badly filled belt or a belt with worn or loose pockets. The cartridges passing unevenly from the belt prevent it entering or passing freely through the feed block.</p>	<p>(ii) (a) Carefully examine belt, seeing that the cartridges are pushed well home.</p>	<p>(ii) (a) Pull out the fourth inch. Perform half the loading motions; pull the crank handle slowly back until the horns of the extractor have engaged with the steps on the solid cams. Draw the recoiling portions to the rear by forcing the knob of the crank handle forward, and tail to the rear at the same time pulling the belt to the left. Allow the recoiling portions to go forward. Bring the crank handle on to the roller and let go. For range purposes: Fill a belt badly.</p>
<p>NORR.*—In order to do this, it may sometimes be necessary for No. 2 to open the front cover and force down the horns of the extractor.</p>	<p>(ii) (b) Belt box not being in line with the feed block: the belt does not lead up correctly to the feed block and becomes jammed.</p> <p>NORR.—The effect of a fault in feed is that the top pawls of the feed block slide, being engaged behind a cartridge in the belt, are held fast when some obstruction such as above, prevents the belt from passing freely through the feed block. The recoiling portion being connected by the top and bottom levers to the slide is arrested and prevented from going home. The distance it is held back depends upon the point at which the obstruction asserts itself.</p> <p>(iii) (a) Damaged cartridge grooves. (b) Broken gib. (c) Broken gib spring.</p> <p>In these cases the cartridge is prevented from passing freely down the face of the extractor.</p> <p>(d) Thick-rimmed cartridge.</p>	<p>(ii) (b) Belt box not being in line with the feed block: the belt does not lead up correctly to the feed block and becomes jammed.</p>	<p>(ii) (b) Carefully examine belt, seeing that the cartridges are pushed well home.</p>	<p>(ii) (b) For range purposes: Place the belt box at an angle to the feed block.</p>
<p>(iii) If the slide is free, No. 2 opens the front cover and forces the extractor down, while, <i>at the same time</i>, No. 1 pulls the crank handle on to the roller. No. 1 lifts up, clears, changes the lock, No. 2 removes the cartridge in position in the feed block, and No. 1 reloads.</p>	<p>(a) Turn the crank handle on the roller, pull the belt to the left, front and let go the crank handle.</p> <p>(b) If this fails, place crank handle on to the roller twice, change the lock and reload.</p>	<p>(a) (i) Defective ammunition. (ii) No cartridge in the chamber. (b) (i) Broken or damaged firing pin. (ii) Broken lock spring.</p>	<p>(a) Load and press the thumb piece. (b) The effect of these will be simulated by placing three dummy cartridges in the belt.</p>	<p>(iii) Damage the rim of the second dummy cartridge in the belt. Proceed to load. NOTE.—As damage to the extractor has to be simulated by damaging a cartridge rim, this cartridge must be removed before reloading. For range purposes: Damage the rim of a dummy cartridge and place it in the belt. (a) Load and press the thumb piece. For range purposes: Place a dummy cartridge in the belt. (b) The effect of these will be simulated by placing three dummy cartridges in the belt.</p>
<p>IV.</p> 	<p>Indication. That there has been no explosion or that there has been little or no recoil, the lock remaining in its forward position.</p>			

### Other Stoppages.

*Damaged parts of the lock, no spare being available.*—The gun will fire without the sear, or if the bents of the sear or firing pin are badly worn or broken off, but only single shots, and only by pressing and releasing the firing lever quickly. The gun will also fire if the nose of the trigger and bent of the tumbler are badly worn or broken off, also if the short arm of the lock spring is broken a short distance from its end, causing it to bear on the wrong side of the axis of the trigger, but only rapid firing. In this case the gun will fire the instant the crank handle reaches the check lever, although the firing lever has not been pressed. If this occurs during firing, to stop the gun the filled end of belt should be thrown over the breech casing to the left.

If the sear and firing pin action only is in good order, the gun can be worked as follows:

(a) Group the cartridges in the belt, say 20 or 30 rounds in each group.

(b) Lay the gun before commencing to load, place crank handle on roller, pull belt to left, and let handle go; repeat, but before allowing the handle to reach check lever, and the gun to fire, grip rear cross piece with left hand to control gun in the ordinary way.

When firing has been stopped by throwing the belt over the breech casing as described above, hold the crank handle with the right hand, open front cover, press down the horns of the extractor, draw the lock back, open the rear cover, and, if there is a live cartridge on the face of the extractor, remove the belt, close the cover and allow the lock to fly forward, when the live cartridge which is on the face of the extractor will be fired automatically. The lock can then be changed with safety. On no account should the lock be allowed to fly forward until the belt has been removed and the cover shut.

If, on drawing the lock back, it is found that there is no live cartridge on its face, the lock may be changed at once, and the necessity for removing the belt and the subsequent precautions will not arise.

## GENERAL INSTRUCTIONS FOR THE MAINTENANCE AND PRESERVATION OF GUNS.

For cleaning and oiling Machine Guns and mountings in the hands of the troops the following stores are allowed per annum in peace, for one gun and its mounting:

Dubbing . . . . .	$\frac{1}{2}$ lb.
Flannelette, Mark II . . .	11 yards.
Old linen . . . . .	3 lbs.
Mineral oil, burning . . .	$\frac{1}{2}$ pint.
Russian petroleum for lubricating . . . . .	8 pints.
Spirits of turpentine . . .	1 pint.
Soap, yellow . . . . .	4 bars.

### To Clean the Barrel.

Open the cover, pull the crank handle over against the roller, raise the lock and let it go forward slowly and rest upon the top of the breech casing. Take off the outer casing and muzzle cup of the ball-firing attachment. Place a piece of flannelette, about 4 inches by 2 inches, *in each eye or slot of the cleaning rod*, care being taken that the latter is surrounded with the flannelette, which should be well oiled; then insert the rod into the muzzle of the barrel, placing the movable bush on the muzzle, and pass it up and down

till the barrel is clean; replace the oiled flannelette by dry pieces, and finally pass freshly oiled pieces through, leaving the barrel well oiled. If the flannelette is tight, and is pushed through the breech, it is necessary to reverse it before pulling it back, otherwise it will jam.

When ball ammunition has been fired, daily cleaning of the barrel is necessary for at least ten days afterwards. Subsequent cleaning must depend on the discretion of the officer in charge of the gun; in a dry climate, once a week should be sufficient, but in situations where the barrel is exposed to a moist atmosphere it may be necessary daily. The bore should at all times be left coated with oil.

When the D.P. barrel has been used for firing blank ammunition it should be thoroughly cleaned as soon as possible and left coated with oil. Subsequent weekly cleaning should suffice, but this must also depend on local conditions.

### To Use the Double Pull-through.

If slight rust or metallic fouling is present, take off the outer casing and muzzle cup of the ball-firing attachment. Remove the barrel, place the muzzle protector in position, and, having thoroughly oiled the gauze, drop the weight through the bore from the breech end. Fix the barrel in a vice or have

it held firmly by two men, and with the assistance of another man pull the cord backwards and forwards until the fouling or rust is loosened; the barrel can now be cleaned with the cleaning rod and flannelette as described above. When by compression the gauze fits too loosely to clean the grooves of the barrel, its diameter can be increased by inserting under each side narrow strips of flannelette or paper. When the gauze is worn out, it should be replaced by one of the spare pieces which are issued with each double pull-through.

#### Cleaning of Mechanism.

To clean the mechanism, a mixture of *equal parts of Russian petroleum and paraffin* should be used. If any parts are clogged with dried oil, spirits of turpentine should be used to remove it. After cleaning each part, it should be thoroughly dried and slightly oiled with Russian petroleum. Very little oil should be used for this purpose, as it is apt to catch the dust and clog.

The plan of hanging the lock and moving the recoiling portion by pulling on the tail of the crank handle affords a ready means of *oiling the recoiling portion and bearing parts of the barrel, viz., (a) just in front of the trunnion block (which can be got at by removing the feed block), and (b) at the muzzle end, in front of the packing gland,*

#### Hanging the Lock.

The lock is hung as follows: Pull the crank handle slowly backwards till the horns of the extractor drop into the steps on the rear face of the solid cams. The barrel and side plates can now be moved backwards by placing the thumb behind the knob of the crank handle and the two first fingers on the tail of the handle and rotating it.

#### Treatment in Frosty Weather.

In frosty weather, when water is kept in the barrel casing, a blanket or some other thick covering should be kept wrapped round the barrel casing to prevent the water freezing. The working parts of the gun should only be slightly oiled with a lightly-oiled rag. In climates where the temperature is likely to fall much below freezing point, not more than about 5 pints of water should be put into the barrel casing (50 per cent. of glycerine mixed with the water will prevent it from freezing so quickly).

#### When Stowed Away.

When guns are returned to store, packed for transmission, or stowed away in any place where they cannot be readily examined, the barrels and unpainted parts should be coated with "Composition, preserving, arms." The mixture is to be made hot, and a piece of flannel dipped in it, with which the exterior

parts will be dabbed. To coat the inside of the barrels draw a bunch of lamp cotton, well saturated with the mixture, through from both ends; the lamp cotton is to be attached to a piece of twisted copper wire.

#### HISTORY SHEET.

A memorandum of examination or history sheet accompanies each gun when issued. It will be carefully preserved and will be handed over with the gun to which it belongs whenever the gun is transferred from the charge of one officer to that of another, particulars being duly recorded. An immediate record will be made in the sheet of any accident which may happen to the gun, and of the result of each official examination it may undergo. *On every occasion on which ball ammunition is fired, the number of rounds fired will be shown, the number of the barrel being inserted in the column of remarks.*

### **POINTS TO BE ATTENDED TO BEFORE, DURING, AND AFTER FIRING.**

It is most important that every gunner should gain familiarity with the points outlined below, and that every firer should carry them out for himself on the range.

The smooth working of the gun almost entirely depends upon the observance of these points, and instructors cannot emphasize them too much.

#### **I. POINTS TO BE ATTENDED TO BEFORE LEAVING CAMP OR BARRACKS FOR FIRING.**

##### (a) Oil Up.

The surfaces on which all movable parts work should be thoroughly well oiled with petroleum, especially the following:

Bearing parts of the barrel, and all recoiling portions.

The lock guides on the side plates, also the working parts of the lock itself, especially the levers and extractor.

Face of the feed block and the edges of the guides inside the feed block.

Bearings of the crank and lock bearings on inside of cover.

##### (b) Test Friction of Recoiling Portion.

In order to see that the recoiling portions work freely, cock the lock, remove the fusee spring box and spring, turn the crank handle

upwards, take hold of it with the right hand and the fusee with the left, move the recoiling portions, with the gun horizontal, backwards and forwards, to see that they work freely, and also that the barrel goes close home forward. The weight necessary to move the recoiling portions should not exceed 4 lbs., measured by placing the loop of the spring balance over the end of the crank shaft (or fusee) and pulling to the rear when the handle is slightly above the horizontal.

(c) To Weigh and adjust Fusee Spring.

Take out the lock; place the loop of the spring balance over the knob of the crank handle, and, standing on the left side of the gun, press down the check lever with the left hand. Pull the spring balance vertically up, resting the right wrist on the breech casing. The reading indicated when the crank handle commences to move will be the weight of the fusee spring. This weight should be between 7 and 9 lbs. If the spring is over, or not up to weight, adjust by means of the vice pin. Generally 6 clicks (3 revolutions) make a difference of about 1 lb. Adjust by  $\frac{1}{2}$  lbs. as a rule.

Turning the vice pin clockwise increases the weight, and vice versa.

The tension of the spring should always be kept as high as possible consistent with maintaining the normal rate of fire of 500 rounds per minute.

(d) Examine Barrel, etc., and clean Bore.

Examine the barrel, to see that the bore is clear; also the tripod, clearing plug, lock, and other important parts.

(e) See to Water Supply.

See that the barrel casing is filled with water. To fill the casing, remove the screwed plug at the breech end, also the cork plug, pour in the water, and replace the plugs.

(f) Oil in Handles, etc.

Ensure that the handles have been filled with oil, and that screwed heads are tight; ascertain that the spare lock and feed block, and also the clearing plug and cleaning rod, are with the gun.

(g) Examine Belts.

Examine the belts, inspect the brass strips, see that the belts are correctly filled and packed carefully in the ammunition belt boxes. Keep the belts dry if possible; should they get wet, lay them out to dry. New or stiff belts should be well plugged.

(h) Water Frozen.

Should the water in the barrel casing become frozen solid, on the gun being fired the barrel will probably not recoil far enough to work the gun, and will remain back. To

remedy this, turn the crank handle on to the roller, then bring it back to a vertical position and force the barrel to the front, pulling the belt if necessary; let the crank handle return to the check lever, and fire the gun. This should be repeated until the barrel recoils correctly.

### **Points to be Attended to During Firing.**

#### **(a) Watch Water Supply.**

See that a sufficient supply of water is kept in the barrel casing, so that the barrel is never uncovered.

The water in the barrel casing begins to boil when the gun has fired about 600 rounds with the greatest rapidity; after this, if the firing is continued, the amount of water evaporated is about  $1\frac{1}{2}$  pints for each 1,000 rounds. When the barrel casing is filled with water about 2,000 rounds may be discharged at short intervals without replenishing, but this depends upon the rapidity with which the gun is fired.

#### **(b) Belt Not Pulled.**

The belt is on no account to be pulled when the gun is firing.

#### **(c) Temporary Cessation: Oil Up and change belt.**

During a temporary cessation of fire, oil the lock and all frictional parts, remove a

partly used belt, and replace it by a full one. Take steps to replenish oil and water if necessary.

#### **(d) Ammunition Box Up and In Line.**

Keep the belt always in line with the feed block and the ammunition box, if possible, up to, but not above, the cross-head joint pin.

#### **(e) Belts Refilled.**

See that the belts are refilled without delay.

#### **(f) Clamps.**

See that clamps of tripod legs do not work loose.

### **Points to be Attended to After Firing.**

#### **(a) Unload.**

See that the gun is unloaded and the lock spring released.

#### **(b) Oil Bore.**

See that the chamber and bore are well oiled *immediately* after firing.

#### **(c) Gather Live Rounds from Cases.**

See that any live cartridges that happen to be among the cases are collected.

#### **(d) Clamp up Before Moving.**

See that before moving, the shutter is closed, the gun is securely fixed by clamping the

traversing gear, and that all pins are secure in their holes, so as to prevent damage to pins or cords.

(e) Thorough Cleaning in Quarters.

On return to quarters the gun and the barrel should be thoroughly cleaned as soon as possible, and the interior left coated with oil; the lock should be taken out and thoroughly examined to ensure that there has been no breakage. It will not be necessary to strip the lock for this purpose. Ammunition belts should be examined, and if wet or damp should be hung up to dry. Remove side plates and barrel, oiling the outside as well as the bore. The boiling water method of cleaning the bore should be applied when possible.

ABBREVIATED MEMORY TABLE OF			
POINTS TO BE ATTENDED TO BEFORE, DURING, AND AFTER FIRING.			
	<i>Before Firing.</i>	<i>During Firing.</i>	<i>After Firing.</i>
1	Oil up.	Watch Water Supply.	Unload.
2	Test Recoiling Portion.	Belt not pulled.	Oil Bore.
3	Weigh Fusee Spring.	Temporary Cessation. Oil up and change belt, etc.	Release Lock Spring.
4	Examine barrel, spare parts, etc.	Ammunition box up and in line.	Gather live rounds from cases.
5	See to Water Supply.	Belts refilled.	Clamp up before moving.
6	Oil in handles, etc.	See clamps of tripod legs not loose.	Thorough cleaning in Quarters.
7	Examine belts.		

### Allocation of Duties.

The various duties to be carried out by the officer, non-commissioned officers and numbers of a section are enumerated below.

It is important that all numbers should be interchangeable in order that casualties may be efficiently replaced in action. In training, the numbers should frequently change rounds as directed below.

The duty of keeping the gun firing under all circumstances when required should be a point of honour with machine gunners.

**The Section Officer.**—To command his section in accordance with his orders and the tactical situation; to select gun positions, give instructions to the sergeant regarding such positions, line of fire, and target; give instructions to range takers as to objects on which to range; call up guns and give necessary instructions to Nos. 1 under cover if possible; decide aiming mark, method of sighting, and fire; order the opening of fire; observe; order necessary alterations of point of aim or sighting; control fire generally; cease fire; withdraw; abandon guns temporarily or advance as circumstances dictate; watch the tactical situation; regulate the ammunition supply, and give general instructions regarding the movement of limbered wagons. He should be particularly expert in observation of fire.

**Sergeant.**—To supervise guns coming into action as the section officer may direct. Be

conversant with the situation and instructions received by the section officer; at once assume command of the section in the event of the officer becoming a casualty or being temporarily absent; he must be thoroughly acquainted with the duties of a section officer as regards tactical handling and control of fire, and should be practised, in this respect, occasionally. He must be proficient in observation of fire and in handling the gun.

**Corporal.**—He is generally responsible for the packing and contents of the limbered wagon. On the line of march he marches behind it, and works the brake as required. On the order to unpack he will lower the tail board, superintend the unpacking, and take command in the absence of the section officer and sergeant. He will have the spare parts box handy, supervise the ammunition supply and filling of belts; direct the limbered wagon as required; superintend the filling of sandbags, cutting of brushwood, and watch for signals from the section officer. He will be prepared to take the place of the sergeant should he become a casualty, and must therefore be thoroughly acquainted with the duties. He should occasionally act as sergeant during training. He must be particularly proficient in the use of the belt-filling machine and in filling belts by hand.

**Gun Numbers.**—In order that each man may be thoroughly trained in peace in the

various duties connected with the gun, it is suggested that a number of each detachment should be detailed on a weekly roster to clean and look after his detachment gun. He will personally clean the gun and be responsible that the mechanism is kept in thoroughly good working order. The duty number for the week will act as No. 1 for any tactical exercises or field days that may occur during his tour of duty. When relieved, he will become No. 2 for the next week, and so on in succession.

The following are the duties of the various numbers:

No. 1 is the firer. He will personally clean and look after his gun; ensure that the mechanism is working smoothly. On going into action he will carry the tripod and place it in a suitable position, and assist No. 2 in mounting the gun. He repeats all orders received, observes his own fire, and makes necessary alterations of elevation and direction. He is responsible that the condenser is attached to the gun before the water boils.

No. 2 assists No. 1 at the gun, carries the gun into action, and mounts it with the assistance of No. 1. He will carry the spare parts case. In action he will *watch for signals* from the section or company officer, *attend to the feeding of the gun*, and generally assist No. 1.

Nos. 3 and 4 are ammunition carriers. No. 3 takes the first supply of ammunition from the limber to the gun, and is responsible that the condenser reaches the gun position before there is any chance of the water boiling. He will also, when possible, carry out minor repairs whilst the gun is in action. No. 4 takes ammunition from the limber to No. 3 as a further supply is required, and also the condenser complete and half-filled with water.

Nos. 5 and 6 are spare numbers and will be used to replace casualties, carry ammunition or fill belts as ordered by the section or sub-section officer.

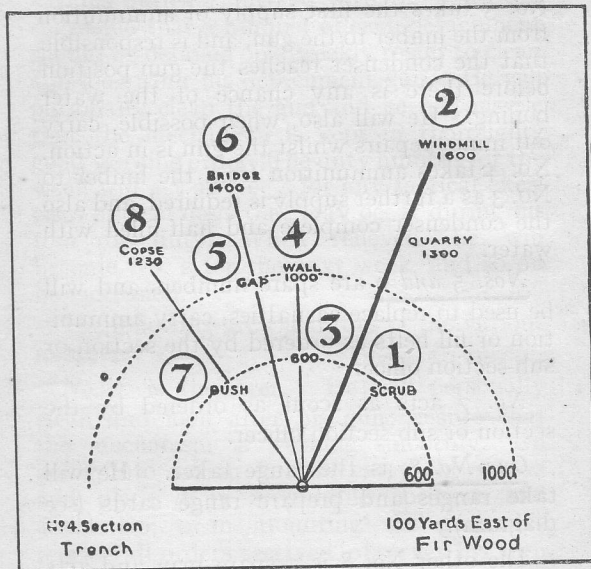
No. 7 acts as scout as ordered by the section or sub-section officer.

One No. 8 is the range taker. He will take ranges and prepare range cards (see diagram).

The other No. 8 is a spare man and acts according to the orders he receives from his officer.

Drivers.—The transport drivers of the limbered wagon and small arms ammunition cart should be frequently exercised with the section, in order that they may thoroughly understand the necessity for taking advantage of ground to reduce visibility, and may learn to act on signals to move as required. They should also be

## RANGE CARD.



taught to fill belts by hand and with the machine, and in addition should receive sufficient instruction in the duties of the gun numbers to enable them to replace casualties in an emergency.

**Signalling.**—Machine gunners should have a thorough knowledge of Machine Gun Signals.

Every man must be capable of :

- |                  |                   |
|------------------|-------------------|
| 1. Firing.       | 4. Signalling.    |
| 2. Observing.    | 5. Small Repairs. |
| 3. Belt Filling. | 6. Bomb Throwing. |

A knowledge of mining is also of great value to machine gunners.

**Belt Filling.**

1. The corporal and all the numbers, as also the drivers of the limbered wagon and S.A. ammunition cart, should be instructed and frequently practised in belt filling, both by hand as well as by the belt-filling machine.

2. **One man—loading by hand.**—Sit on the ground with the right foot doubled under the left thigh, the left foot, resting on the outer side and drawn towards the right knee.

Place the belt on the left knee, with the tag pointing to the right. Take hold of the first brass strip between the forefinger and thumb; then with the remaining fingers and ball of the thumb, hold the belt so that the pockets will remain open. Take a few cartridges in the right hand, insert into pockets, taking care to avoid doubling over the thin edge of webbing. Now place the belt on the knee, and placing the tips of the fingers on the front of the belt, finally adjust the cartridges by pushing them forward with the thumb until the points of the bullets are in line with the ends of the long brass strips. Continue to

load and adjust in fives, and make a final inspection when placing the belt in the box.

The same method should be followed when filling metal belts, the neck of the cartridge case being pressed home against the front clips.

### 3. Belt-filling Machine. (See Plate VII.)

*Description.* The belt-filling machine is designed to place the cartridges expeditiously and evenly in the ammunition belts, and is constructed so that it may be readily clamped on to the most convenient place.

*Instructions for use.* The machine must be fixed so that the crank handle can be worked with the right hand. The loading tray and the leg should be unfolded. The leg should be made rigid by turning up the keeper plate on to the pin catch, and the loading tray secured to the left of the bed plate by means of the pin, which is attached by a chain to the former. Turn the steel guide plate on the bed plate outwards; see that the pocket opener is back far enough to clear the belt; place the belt behind the roller and into the belt guide, the edge of the belt to be touching the side of the guide, the projecting ends of the long brass strips to point away from the cartridge plunger and to pass under the steel guide. The pawl lies on top of the belt. Turn the steel guide plate into position again, and draw the belt through with the left hand until the first pocket is opposite the pocket opener. Fill

the hopper with cartridges, and replenish as required. On revolving the crank handle, the pocket opener will enter the first pocket and open it; on continuing the motion, the pocket opener will be withdrawn, and the cartridge plunger will push the lowest cartridge from the column of cartridges into the pocket; the pawl will then feed the belt along and these motions will be repeated until the belt is filled.

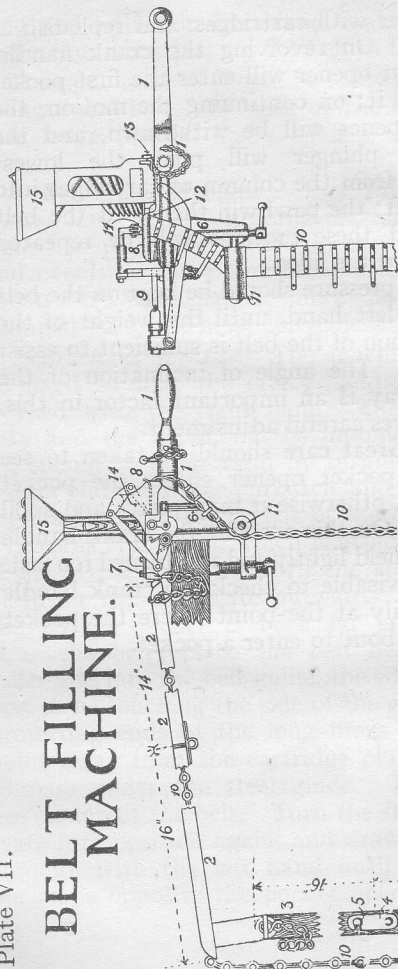
A light pressure should be kept on the belt with the left hand, until the weight of the filled portion of the belt is sufficient to assist the pawl. The angle of inclination of the loading tray is an important factor in this, and requires careful adjustment.

N.B.—Great care should be taken to see that the pocket opener enters the pocket each time, otherwise it may pierce and spoil the belt. On this account the crank handle should be held lightly and not turned too fast.

It is advisable to check the crank handle momentarily at the point where the pocket opener is about to enter a pocket.

Plate VII.

# BELT FILLING MACHINE.



1. Removable Crank Handle with Fixing Pin and Chain.
2. Hinged Loading Tray.
3. Hinged Leg.
4. Keeper Plate.

5. Pin, Catch.
6. Bed Plate.
7. Pin, Joint, Bracket.
8. Plate, Guide.
9. Pocket Opener.

10. Belt.
11. Belt Roller.
12. Belt Guide.
13. Cartridge Plunges.
14. Pawl.
15. Hopper.

## ELEMENTARY DRILL.

1. **Laying.**—Laying instruction should proceed simultaneously with elementary drill.

Special care will be taken that the sights of all guns are in perfect order.

The aiming mark in the earlier stages will be clearly defined, such as a bull's-eye, and placed at a distance not exceeding 100 yards, but when the habit of accuracy has been acquired service targets will be used, and care will be taken that there is no falling off in accuracy owing to the shape and comparative invisibility of these targets.

The instructor must inspect the sights frequently to ensure that they are correctly adjusted in accordance with his orders.

He will explain the following rules, and demonstrate the results to be anticipated from common errors in laying.

- (i) The sights must be kept upright.
- (ii) The left or right eye may be used. The eye not required for laying must be closed.
- (iii) Aim must be taken by aligning the sights on the centre of the lowest part of the mark, the top of the foresight being in the centre of, and in line with, the shoulders of the U of the tangent sight.
- (iv) With the aperture sight, aim must be taken by looking **through** the aperture and aligning the top of the foresight in its centre and on the lowest portion of the mark.

Diagrams will be freely used to illustrate the correct methods of laying.

When these principles have been mastered, the instructor will lay the gun on the target without taking "holding" pressure; the eye to be approximately 6 inches behind the rear cross piece. It is necessary to steady the head during the elementary lessons in laying. In the sitting position the head may be supported between the hands; when other positions are assumed, belt boxes may be used.

Having laid the gun, the instructor will direct those under instruction to observe the correct method of aligning the sights on the mark. Each gunner will then act similarly, when the instructor will verify the aim, pointing out errors and explaining how they would have affected the accuracy of the fire, and how they are to be avoided. He should occasionally call on a man to point out any errors which may have been made by his comrades.

Extreme accuracy of laying must be insisted upon even during the first lessons.

**Use of the Battle Sight.**—The battle sight has the following advantages:—

(a) It increases the rapidity with which fire can be applied at short ranges, owing to a fixed elevation being provided.

(b) Its use will decrease the probability of the gun being located as the tangent sight is not raised. The instructor will explain:—

Up to 500 yards, the battle sight will be used, and if fire is observed short, the elevation will be altered by an automatic turn of the wheel.

To facilitate the ready application of fire at ranges beyond the limits of the battle sights, the slide of the tangent sight will be normally adjusted to 600 yards.

2. The guns, with tripods and ammunition boxes, will be placed on the ground, muzzles to the front and in line, legs to the rear and clamps sufficiently tight to prevent the legs from hanging loose when the tripod is lifted off the ground; the traversing clamp should be sufficiently loose to enable the gun to be deflected by a sharp tap with the hand on the rear cross piece; guns on the right, ammunition boxes 3 paces in rear of the guns. The guns should be a convenient distance apart, but not closer than 8 paces.

3. On the command "**Fall In,**" the subsection will fall in in two ranks, 5 paces in front of the interval between the guns; the sergeant on the left of the front rank, covered by the corporal in the rear rank. The front rank will provide the right gun detachment, the rear rank the left gun detachment. (*See Plate VIII.*)

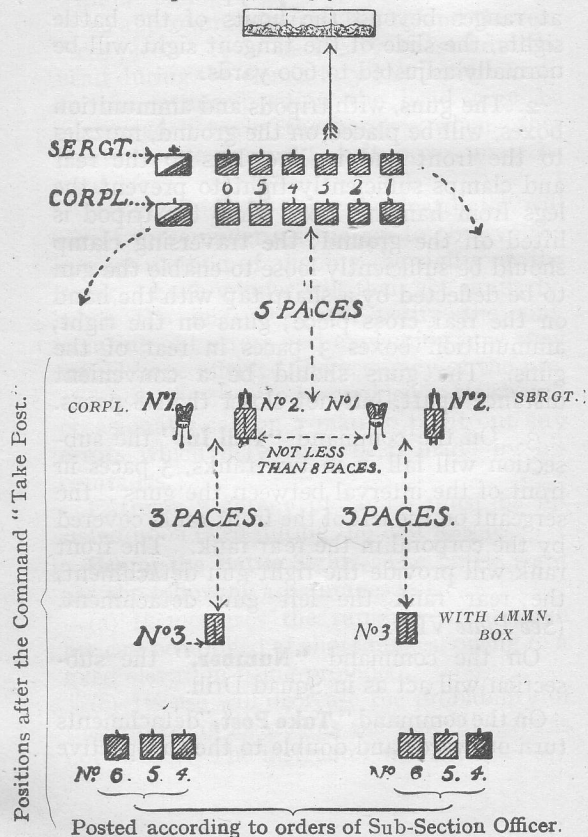
On the command "**Number,**" the subsection will act as in Squad Drill.

On the command "**Take Post,**" detachments turn outwards and double to their respective

## Plate VIII.

POSITION OF GUNS, MOUNTINGS AND GUN  
NUMBERS AT COMMENCEMENT OF  
ELEMENTARY DRILL.

Landscape Target, 25 yards from Guns



guns (the sergeant and corporal on the outer flank, where they can superintend). Nos. 1 and 2 fall in on the left of the tripod and right of the gun respectively, No. 3 on the left of the ammunition box. If the ground is suitable, these numbers should lie down. Nos. 1, 2, and 3 at once examine the tripod, gun, and ammunition belt respectively, Nos. 2 and 3 reporting when correct to No. 1.

Nos. 4, 5 and 6 are posted as ordered by the instructor. (See Plate VIII.)

4. A landscape target should be placed about 25 yards from the guns, and a point of aim indicated. The instructor having pointed out a spot—not more than 5 yards away, where each gun will be mounted—will give the command "**Mount gun.**" No. 1 picks up the tripod, carries it to the spot ordered, and places it in position. In adjusting the tripod he must ensure that the socket is upright and that the legs are clamped tight. He must learn by experience the adjustment that suits him best for the position ordered and for the nature of the ground, so that he will not be cramped when firing and will not have to alter the tripod after the gun has been mounted.

As soon as the tripod is nearly in position No. 2 picks up the gun and carries it to the right side of the tripod, first pressing back the shutter, holding the rear cross piece with

the left hand, with the gun, muzzle to the rear, under the right arm. He then kneels on the left knee, facing the tripod, and, supporting the weight of the gun on the right knee, places it on the tripod, drives in and turns down the cross head joint pin, and removes the cork plug from the steam escape hole. No. 1 fixes the elevating joint pin, directs the gun towards the mark and "holds" correctly. Meanwhile No. 2 lies down and places the ammunition box in position.

No. 2 should time his advance so as to reach the tripod at the moment its adjustment is completed.

When No. 3 sees the gun is nearly mounted, he carries the ammunition box forward and places it within reach of No. 2. The ammunition must be at hand directly No. 2 is ready for it. No. 3 then retires to a covered position not immediately in rear of the gun.

When the instructor criticises the mounting of a gun on the Mark IV Tripod, his criticism should follow a definite sequence so that no point is overlooked. For example :

(a) *Tripod.*

Legs.  
Clamps.  
Socket.  
Pins.  
Elevating gear.

(b) *Gun.*

Direction of muzzle.  
Cork plug.  
Shutter.  
Approximately level.

(c) *Box.*

Up and in line.

(d) *No. 2.*

No undue exposure.  
Reasonable position.

(e) *No. 1.*

Correct holding.

5. On the command "**Load,**" No. 1 at once pulls the crank handle on to the roller. No. 2 passes the tag of the belt through the feed block. No. 1 pulls the belt to the left front as far as it will go and lets go the crank handle. He releases the strain on the belt, then turns the crank handle on to the roller; he again pulls the belt to the left front and lets go the belt and crank handle. The gun is now loaded and ready to fire. **Each motion should be distinct and clean.**

**Single Shot Loading.**—When it is desired to practise men in single shot loading, the gunner should carry out the first half of the loading motions. Then, without touching the belt, turn the crank handle on to the roller and let go.

On the command (range), e.g., "**900,**" No. 1 repeats the order for his own gun,

and adjusts the slide to the elevation required for the distance ordered.

On the command "**At**" (naming the aiming mark), No. 2 adjusts the traversing clamp if told to do so by No. 1, and No. 1 lays the gun, maintaining the same pressure on the handles while laying as he would when firing. When laying, the aiming eye should be about six inches behind the rear cross piece. No. 2 alters the position of the ammunition box if required.

6. When the gun is laid and the clamp adjusted as required, No. 1 raises the automatic safety catch with the forefinger and prepares to fire. When No. 1 is ready, No. 2 holds up his hand. When concealment is important the left hand held out behind No. 1 is the best means of indicating that No. 1 is ready to fire. As proficiency increases, the pause between naming the object and the range should be slight.

On the command or signal "**Fire**," No. 1 presses the thumb piece.

On the command or signal "**Cease Fire**," No. 1 releases the automatic safety catch, and remains steady.

#### **Horizontal Traversing.**

7. Frequent instruction will be given in Traversing Fire. The firer must first ensure that the traversing clamp is just sufficiently loose to enable the gun to be deflected by means of a sharp tap with the hand on the rear cross piece. Each man must learn by

experience the exact degree of clamping he requires, and, before firing, he should ensure that the clamp is correctly adjusted to suit himself.

Traversing fire is applied by means of a series of groups fired at regular intervals within certain limits indicated by such figures on the target as may be ordered by the instructor.

The target will be the instructional machine gun target described on page 116.

The procedure for horizontal traversing is as follows:

The instructor having described the figures between which fire is to be directed, will order "**Traversing**," followed by the signal to "**Fire**." The firer will lay the gun on the flank figure named and press the thumb piece, then tap the gun approximately to the centre of the interval to the next figure, again press the thumb piece, then tap, and so on until the limit ordered has been reached. The firer should be taught to fire groups of about 8 rounds by maintaining pressure on the thumb piece for about one second at each group. By this method he learns to tap the gun with the necessary force in order to avoid firing more than one group at the same place, and also to avoid leaving gaps in the line he is traversing.

#### **Diagonal Traversing.**

8. As proficiency increases, instruction should be given in diagonal traversing. In

this case the target will be three bands, each with three figures, as for horizontal traversing. The bands will be joined so that each of the outer bands is in the same vertical plane as the centre band, and forms an angle of 120 degrees with it. In this case the firer is taught to combine the use of the elevating wheel with tapping for deflection. The same principles as for horizontal traversing apply for this diagonal traversing.

Instruction should be afforded in traversing from right to left, as well as from left to right.

During the instruction fire should be stopped at least twice in order to check the laying, and also to measure the distance traversed. By comparing the distance traversed with the number of groups fired, an estimate can be deduced as to the value of the traversing fire. For example: Traversing fire is ordered from the 1st to the 6th figure; fire is stopped after the 4th group. If the traverse has been correctly carried out, the gun should be laid on the interval between the 2nd and 3rd figures.

### Swinging Traverse.

9. The method is employed against dense targets at close range.

It in no way replaces the method of traversing by automatic tapping.

The Swinging Traverse is taught by teaching a man to traverse a machine gun instruc-

tional target evenly and smoothly in about 6 seconds.

The importance of the socket being perfectly upright should be emphasised.

10. On the command "**Unload**," No. 1 lowers the tangent sight (if raised), but not the slide, turns the crank handle twice in succession on to the roller, letting it fly back each time on to the check lever; then releases top and bottom pawls, while No. 2 withdraws and repacks the belt in the box; this must be done correctly, and the lid closed and fastened; No. 1 releases the lock spring by pressing the thumb piece.

11. On the command "**Dismount gun**," No. 1 removes the elevating and cross head joint pins, No. 2 replaces the cork plug, passes the ammunition box to No. 3, removes the gun as in mounting, and replaces it in its original position in rear, first closing the shutter. No. 1 follows with the tripod. On reaching the original position, he sees that the joint pins are home and turned down, and then folds and clamps the legs.

12. On the command "**Action**," followed by Range and Aiming Mark, the gun will be mounted, loaded, and laid as described in the previous paragraphs, No. 2 raising his hand to indicate when the gun is ready for firing.

On the command, or signal—"Out of Action"—the gun is at once unloaded

without withdrawing the belt and carried or drawn back, by means of the rear leg, under cover, or to the original position, then dismounted in the usual way.

### Elementary Drill Briefly Summarized.

Words of Command.	Duties, etc.
"Fail in."	} See Plate VIII. No. 1 Looks to screws of elevating gear, etc. No. 2, gun. No. 3, belt.
"Number."	
"Take Post."	
<i>No. 1 Repeats all Orders.</i>	
"Mount Gun."	No. 1 Adjusts tripod, clamping legs tight. No. 2 Mounts gun, drives in cross-head pin and removes cork plug.
"Load."	Motions distinct and clear.
"At" (Elevation required).	No. 1 Repeats order for own gun, adjusts sight.
"At" (aiming mark)	No. 1 Lays gun. No. 2 Adjusts traversing clamp to suit No. 1, and when ready holds up his hand.
"Fire."	No. 1 Presses thumb piece. Ranging-fire. Groups of 10 to 20 rounds. Rapid fire 30 to 50 rounds.
"Cease Fire."	No. 1 releases safety catch and remains steady.
<i>For Traversing Fire.</i>	
From—Figure	No. 1 lays gun on flank figure named, presses thumb piece, then gives gun one tap, again presses thumb piece, then tap, and so on till limit is reached.
To—Figure	
"At" (Range).	
"Traversing Fire."	
"Unload."	No. 1 Down sight with left hand. Turns crank handle twice over with right hand. Releases pawls, then presses thumb piece.
"Dismount Gun."	No. 2. Withdraws and repacks belt in box.
	No. 2 Replaces cork plug, passes ammunition box back to No. 3 and removes gun.
	No. 1 Follows with tripod, sees joint pins home and turned down, folds and clamps legs.
Range Target.	Gun mounted, loaded, and laid on aiming mark, but not fired.
"Action."	Gun unloaded and drawn back under cover—
"Out of Action."	then dismounted.

13. Instruction should be afforded in bringing the gun into action in the several positions of the tripod, and in various natures of ground. Firing up, down and along the side of steep hills should be practised. Practice should also be afforded in mounting the gun from the prone position, in firing from the lying position, and when kneeling on both knees, as well as when sitting.

### Signals.

1. In many cases observation will be impossible from the gun position, and it will be necessary for observers to signal results from a flank.

The following semaphore code is used in signalling the results of observation of fire:

O = Fire observed over.

S = Fire observed short.

R = Fire observed to right of target.

L = Fire observed to left of target.

K = Fire observed correct.

W = Fire unobserved, or "wash-out."

2. The signaller at the observation post should give the "call up" to show that the observers are ready. "O" and "S" may be repeated for multiples of 50 yards; thus

"OO" would mean, "Fire observed at least 100 yards beyond target." Signals should be repeated from the gun position if this can be done without disclosing the position to the enemy.

3. On all occasions when guns are firing, the following signals should be used in controlling fire:

Signal for "**Action.**"—Both arms fully extended, raised from the sides to a position in line with the shoulders and lowered again. This motion to be repeated until it is seen that the signal is being complied with. *Note.* A machine gun is said to be "*in Action*" when it is mounted, loaded, and laid, not necessarily firing.

Signal for "**Out of action.**"—Arm swung in a circular motion from the elbow in front of the body.

By No. 2.

Hand up. = Gun ready to open fire.

By Controlling Officer.

Hand up. = Preparatory to opening fire.

Hand dropped. = Open fire.

Elbow close to the side, forearm waved horizontally. = Cease fire.

## TESTS OF ELEMENTARY TRAINING.

The following tests have been devised to assist officers in testing the efficiency of their sections in elementary training, and also to ensure that no detail of such training is overlooked. It is important that these tests should not be considered as competitions against time, for, although quickness is necessary, yet accuracy is the first essential. No man should, therefore, be passed as efficient unless all the points are properly fulfilled, even though he may complete them in the standard time.

The tests must be carried out in strict accordance with the detailed instructions given, for, unless the smallest details are insisted upon, the time limit will not be applicable. In carrying out these tests, time can be saved if the first pair complete tests i. to v. consecutively; the remainder can be carried out as convenient.

The entire personnel of a machine-gun section, including, when possible, the drivers, should qualify in these tests, acting both as No. 1 and No. 2. This is necessary, for on service any member of a section may be required to replace a casualty at a moment's notice. In all tests No. 1 will repeat all orders received.

**i. To erect the tripod and mount the gun on the command "Mount Gun."**

The tripod, gun, and ammunition box to be laid on the ground, with Nos. 1 and 2 standing one on each side of them. The clamps of the tripod legs to be sufficiently tight to prevent them from falling loose when lifted; close together, and traversing clamp tight. The cork plug in and shutter closed. The position where the gun is to be mounted to be not more than 5 yards away.

*Points to be observed.*

- (a) Socket to be upright.
  - (b) All clamps tight.
  - (c) Pins home and turned down.
  - (d) Both elevating screws exposed the same distance.
  - (e) Gun pointing to the front.
  - (f) Cork plug withdrawn, shutter open and "T" piece vertical.
  - (g) Nos. 1 and 2, and an ammunition box, to be in position.
  - (h) Tripod adjusted so that the gun is at a suitable height for No. 1 to lay and fire in a comfortable position without constraint.
- Standard time, 20 seconds.*

**ii. To load the gun on the command "Load."**

In continuation of i. Belt, with a few dummy rounds at the end, properly packed in the box, which will be closed and fastened.

*Points to be observed.*

All loading motions to be quite distinct and correct; to be carried out without any slurring. *Standard time, 5 seconds.*

**iii. To adjust the sights and lay the gun on the command "At (Range).....(object)....."**

In continuation of ii. Gun loaded and ready to be laid. Three objects will first be pointed out on a landscape target placed about 25 yards from the gun, but the No. 1 being tested will not know which will be given. Any range may be ordered so long as it will not be necessary to alter the slide by more than 500 yards up or down when the aiming mark is changed.

*Points to be observed.*

That the slide is adjusted and the gun laid with absolute accuracy. When checking the aim, "holding" pressure must be exerted on the handles; this may generally be done most conveniently by the instructor; but, should there be any question of different "holding," the No. 1 should hold the gun while the instructor checks the aim. No. 1 must be careful, however, that he does not exert lateral pressure when leaning to one side to clear the sights. *Standard time, 12 seconds*, from the range being ordered until No. 2 holds up his hand, indicating that No. 1 is ready to open fire.

**iv. To unload the gun on the command "Unload."**

In continuation of iii.

*Points to be observed.*

(a) Tangent sight lowered, but without moving the slide.

(b) Unloading motions to be quite distinct, without slurring.

(c) Belt withdrawn, repacked correctly in the box with lid closed and fastened.

(d) Lockspring released. *Standard time, 5 seconds.*

**v. To dismount the gun on the command "Dismount Gun."**

In continuation of iv. The gun will be dismounted, and, together with the tripod and ammunition box, will be placed in the same position as at the beginning of Test i.

*Points to be observed.*

All the points as at the beginning of Test i. *Standard time, 15 seconds.*

**vi. To bring the gun into action on the command "Action," followed by Range, Object.**

This test combines i. to iii. It emphasizes the necessity for proficiency in all details required before a gun can open fire with effect. This test should, therefore, not be applied until proficiency has been attained in each of those that precede it. The numbers, gun, tripod and ammunition box will be as at the beginning of i.

*Points to be observed.*

All points as laid down for Tests i., ii. and iii. to be fulfilled. When No. 1 is ready to open fire, No. 2 will hold up his hand. *Standard time, 35 seconds*, from "Action" being ordered until No. 2 holds up his hand.

**vii. Horizontal Traversing. On the command "(limits of traverse)..... Traversing"—signal "Fire."**

The target will be a horizontal line of figures, khaki on green, 3 inches high and 4 inches apart from centre to centre, placed at 25 yards from the gun. The gun will be laid on any figure that may be ordered. The test will comprise traversing from *right to left*, as well as from *left to right*. On the command "**Traversing**," followed by signal to fire, No. 1 will fire a group at the figure named, then traverse, so that the next group will be fired at the interval to the next figure; the subsequent groups will be fired at a figure and a space alternately. Each time a group is fired, pressure will be maintained on the thumb piece for approximately 1 second, which is about the time required to fire a group of 5 to 10 rounds. The test will not be completed until the space included between 5 figures, including the first named and the fourth from it, has been traversed. In order to ensure that the traversing is satisfactory throughout, the order to cease fire will be

given at least once during the traverse, but not before 5 groups have been fired, and the laying will be checked; this will be repeated when the limit of the traverse is reached.

*Points to be observed.*

That the traversing clamp is just sufficiently loose to enable the gun to be deflected by a sharp tap with the hand on the rear cross piece; when checking the laying, that the sights are laid approximately correctly; the object is to test the traversing by ascertaining if the strength of tap has been correctly estimated, and not accurate re-laying; tapping backwards to obtain accuracy of aim will not be allowed. By counting the number of groups fired, the point of aim can be calculated, e.g., fire opened on the first figure and stopped after the 7th group has been fired; the gun should then be laid on the fourth figure. *Standard time, 2 seconds for each complete series, i.e., a group and a completed traverse; e.g., in the example above, the time taken should have been 13 seconds, i.e., 6 complete series = 12 seconds; and a group = 1 second; total = 13 seconds.*

**viii. Diagonal Traversing. On the command " (limits of traverse) ..... Traversing "—signal "Fire."**

The target will be three lines of 3 figures as for vii. each joined at an angle of 120 degrees to the next.

The procedure will be as for vii., but in this test correct manipulation of the elevating wheel is included. Traversing will be from *right to left*, as well as from *left to right*.

*Points to be observed.*

As in Test vii. *Standard time, 3 seconds for each complete series, as explained in Test vii.*

**ix. Rectifying stoppages.**

The instructor will indicate the stoppage required by adjusting the crank handle of a spare gun, if available, or by holding a stick against a wall or target to exemplify the position of the crank handle which he wishes to illustrate. For example: Crank handle vertical; immediate action. The other positions of the crank handle can be similarly exemplified.

As an elementary test only, the "immediate action," *vide* Table of Stoppages, will be required, but as proficiency increases the remedy of stoppages may be more fully tested by introducing variations in accordance with the tabulated list of stoppages, 5th column, "Remedy in Detail"; e.g., after the "immediate action" in above example has been applied, keep the crank handle in the same position, telling No. 1 at the same time, "Gun still stops." No. 1 should lighten the fusee spring. In all cases the "immediate action" must first be applied.

*Points to be observed.*

That the correct remedy is applied and completed; that all motions are correctly and clearly carried out; that the gun is relaid correctly after a remedy has been completed. *Standard time: The correct procedure to be begun within 3 seconds of the order "gun stops" from the instructor.*

**x. Belt filling.**

(a) A heap of 25 rounds of ball ammunition to be placed beside a man; these to be inserted in a belt. *Standard time, 1 minute.*

(b) As for (a), but 250 rounds to be inserted in a belt by one man. *Standard time, 12 minutes.*

*Points to be observed.*

Rounds to be placed anyhow in a heap and not arranged. Inspection of the belt on completion will show if it has been filled so as not to cause a fault in feed.

**TESTS OF ELEMENTARY TRAINING.**

Memory Table, Showing Commands, Times, etc.

No. of Test.	Nature of Test with Commands.	Standard Time.	Remarks.
I.	To Erect tripod and mount Gun. "Mount Gun."	20 sec.	Points—As on p. 98.
II.	To load the gun. "Load."	5 sec.	All motions distinct. No slurring.
III.	To adjust sights and lay gun. "At...(Range)...(Object)..."	12 sec.	From range being ordered until No. 2 holds up his hand.
IV.	To unload the gun. "Unload"	5 sec.	Motions distinct, belt correctly repacked, Lockspring released.
V.	To dismount the gun. "Dismount Gun."	15 sec.	All points as at beginning of Test I, and cork plug replaced.
VI.	To bring gun into action. "Action," followed by Range, Object.	35 sec.	All points for Tests I, II and III to be fulfilled. Time taken until No. 2 holds up his hand.
VII.	Horizontal Traversing (Limits of Traverse). "Traversing Fire"	2 sec. for each complete series.	Points as on p. 101.
VIII.	Diagonal Traversing (Limits of Traverse). Traversing Fire.	3 sec. for each series.	Points as in Test VII.
IX.	Rectifying Stoppages.	Correct procedure begun. 3 sec. 1 min. 12 min.	Correct remedy applied and gun relaid after remedy. 25 rounds.* 250 rounds.*
X.	Belt Filling		*Placed in a heap—Pass thorough inspection when filled.

GENERAL MACHINE GUN COURSE FOR SERVICE MACHINE.  
GUN SECTIONS OF THE NEW ARMIES, RESERVE UNITS, TERRITORIAL UNITS,  
AND COLONIAL CONTINGENTS.

*Part I.—Instructional.*

To be fired at a range of 25 yards. Target, Instructional Machine Gun  
Target, Plate 35, Musketry Regulations, Part II.

No.	Nature of Practice.	Rounds.	Method of Conducting and Object of Practice.
1	Grouping	10 (in 2 groups)	<i>To teach the importance of the correct holding required for the gun. During this practice the instructor should watch the firer so as to be able to criticize his method of holding and pressing the thumb piece.</i>
2	Single shot Traversing	10 (5 Right 5 Left)	<i>To teach accurate laying and automatic tapping. Gun to be laid on the flank figure indicated by the instructor; fire a shot and tap alternately as in Section Drill (Traversing Fire). Shots should be approximately 2 inches apart. The result of each shot should be criticized. Single shot loading. It is useful to stop the practice a few times and criticize the firer's actions.</i>
3	Searching	20 (10 up 10 down)	<i>To teach automatic manipulation of the elevating wheel. Single shot loading. The gun to be laid on a figure with sights adjusted to 1,100 yards. Without altering the elevation of the gun, adjust the sights to 1,350 yards. Fire a shot, then elevate and fire, and continue elevating and firing alternately, until the sights are again aligned on the original aiming mark. Each shot should be approximately 2 inches vertically</i>

*above the last. Then traverse about 2 inches inwards and, without altering the elevation of the gun, adjust the sights to 1,100 yards and proceed as before, but depressing after each shot instead of elevating. When the sights are aligned between the figure originally laid upon and the next, the practice is completed, and each shot should be approximately 2 inches vertically below the last. The vertical interval of 2 inches at 25 yards is the horizontal equivalent to 60 yards at 1,000 yards range, or about the depth of the effective zone for the range.*

*To teach correct laying and holding. Two alternate figures to be indicated by the instructor. A group to be applied to the rectangle above each figure. The point of mean impact of each group should be within the rectangle above each figure respectively.*

4 sec. to traverse 6 ft. This allows for a smooth, steady traverse with bullet holes across two-thirds of the target,

4	Application	20 (in 4 groups)	
5	Swinging Traverse	30	
Repetition		20	
Total rounds per man		110	

# M.G. COURSE, Part II.—Classification Practices, 9, 10, only.

No.	Nature of Practice	Target Screen (covered with Brown paper).	Range (Yds.)	Rounds.	Time (secs.)	Remarks
7	Ranging	3' high 10' wide	400	20	—	In these practices each man has an opportunity of sighting his gun on the open range before firing the classification practices. Useful instruction in the practical method of ranging may be imparted in practices 7 and 8. The quickest method is to fire a group, observing the strike; then elevate or depress <i>without touching the tangent sight</i> . Fire again, and turn elevating wheel until nucleus of fire falls on the target. Now the slide should be adjusted <i>without touching the wheel</i> and the aim shows the sighting required to hit the target.
8	(omitted)				—	
9	Application	3' high	400	30	20	Gun to be traversed from <i>right to left</i> . The firer is required to traverse the target with the rounds allotted within the time limit without restrictions.
10	Traversing	3' high 20' wide	400	60	50	
11	(omitted)					Gun to be traversed from <i>left to right</i> under the same conditions as in Practice 10. Range known approximately. If it is probable that the firer can himself observe, he should apply his fire from such observation. The remainder of the section, except a No. 2 to assist the firer, should form two groups under the sergeant and corporal respectively. These groups should observe the fire by eye or with field glasses from the flanks. Each N.C.O. and man should note down the result of his observation of each group fired, and at the end of the practice put
12	(omitted)					
13	Observation	3' high 10' wide	400*	20	†	

\* If a field firing range is not available Practice 11 will be substituted for this practice. See Notes, Part II.

† No limit, but at a rate of at least 250 rounds a minute.

against each note of his observation the semaphore signal he would have sent had he been required to signal results. If the firer is unable to obtain observation himself, another No. 2, not the No. 2 at the time, will control the fire from observation with field glasses, the remainder observing from a flank as described above. After each firer has completed the practice, the section officer will criticize the results of the observation as regards methods followed by firer and observers.

Ranges known approximately. Nos. 1, 2 and 3 will fall in with the gun, tripod and ammunition box, as for the 1st Test of Elementary Training, about 100 yards in rear of first fire position, which will be approximately 700 yards from the targets. The section officer will mark the first and subsequent fire positions, and, on his signal, the gun, etc., will be carried forward at a steady double, and fired without further orders. The gun will be carried dismounted and the tripod legs will be closed and clamped until the first position is reached. Fire will be continued at each position until a hit is obtained. Sights will not be adjusted until the new position is reached. *At alternate fire positions the firer will adopt the prone position when firing. The objects of this practice are to emphasize the lessons of elementary training as regards quick and correct mounting of the gun and quick opening of fire, and also to exemplify the principle of maintaining fire until effect is obtained.* It is often desirable to time the practice or a portion of it. If the section officer decides to do so, the time should be taken until a hit is obtained—not merely until fire is opened, because this encourages men to open fire without accurate laying. The advance to a fire position should not be a race between detachments if both are carrying out the practice simultaneously, nor against time.

\* 10 Rounds will be fired at each of the four distances. These rounds will be "spaced out" before commencing the practice, and the firer will proceed to the next range on completing his 10 rounds, whether he has secured a hit or not.

## GENERAL MACHINE GUN COURSE.

## PART I.

	Rounds allotted.
Practice 1.—Grouping . . . .	10
„ 2.—Single shot, traversing . . . .	10
„ 3.—Searching . . . .	20
„ 4.—Application . . . .	20
„ 5.—Swinging traverse . . . .	30
Repetition . . . .	20
	<hr/>
	110
	<hr/>

## PART II.

(Range 400 yards for all practices except Practice 14.)

	Time Seconds.	Rounds allotted.
Practice 7.—Ranging . . . .	—	20
„ 8.—(Omitted.) . . . .		
„ *9.—Application . . . .	20	30
„ *10.—Traversing . . . .	50	60
„ 11.—(Omitted.) . . . .		
„ 12.—(Omitted.) . . . .		
„ 13.—Observation . . . .	—	20
„ 14.—Fire at successive positions (range 600 yds. to 200 yds.) . . . .	—	40
		<hr/>
Total . . . .		170

\* Classification practices.

Rounds  
allotted.

Part I. . . . . 110

Part II. . . . . 170

Surplus for repetition of indifferent  
shots, to be pooled and used at  
the discretion of the Commanding  
Officer . . . . . 20

Grand total . . . . . 300

## NOTES.

## PART I.

1. *Additional Practice*.—For trench warfare, and against dense targets *at close range*, the "Swinging Traverse" has been found necessary. It in no way replaces the method of traversing by automatic tapping, which should still be considered the normal method. The swinging traverse is taught by teaching a man to traverse a machine gun instructional target evenly and smoothly in about 6 seconds.

## PART II.

2. *Practice 10*.—It will be necessary to shorten the target, as 40 rounds less are allowed for in this practice. This will be done by using two 10-foot screens instead of three. Spaces will be 20 inches.

3. *Practice 13*.—(a) If a field firing range is not available, Practice 11 will be substituted for this practice.

(b) Observation should be taken by three parties, left, right, and centre, who should change round after each firer. Section officers should ascertain that each man has observed from each position.

4. *Practice 14*.—10 rounds will be fired at each of the four distances laid down in Musketry Regulations. These rounds will be "spaced out" before commencing the practice, and the firer will proceed to the next range on completing his 10 rounds, whether he has secured a hit or not.

## CLASSIFICATION.

5. Machine gunners will be classified upon the results which they obtain in Practices 9 and 10, General Machine Gun Course, as follows:—

To be classified as a "1st Class Gunner," 50 points.

To be classified as a "Qualified Gunner," 25 points.

Points will be allotted in the classification practices on the same basis of scoring as laid down in paragraph 647, Musketry Regulations, Part I, 1909 (reprint) 1914.

No man should begin firing with service ammunition until he has correctly passed the Tests of Elementary Training.

It is important that all the points to be observed before, during, and after firing are carefully carried out, in order to render them habitual to all machine gunners.

*Part I* is instructional, and, since it is probably the first time a new machine gunner fires with service ammunition, careful and thorough instruction is necessary throughout the practices of Part I. The trained gunner must also regard these practices as instructional. The best value will be obtained by criticizing each practice while it is in progress, ceasing fire for the purpose, rather than by waiting until it is completed, when

more ammunition will probably not be available with which to correct faults.

In these Practices the firer learns, as he gains experience, to understand thoroughly the peculiarities of his gun and its mounting, and to compensate for them by suitable holding. These points can seldom be learnt without careful instruction and explanation by the section officer.

In the Traversing Practice of Part I no tapping backwards to correct faulty traversing will be allowed. In this Practice, a space exceeding 2 inches without a bullet mark indicates faulty traversing.

The sighting elevation to be used for the instructional machine gun target is 1,100 yards. Aim taken at or in line with the feet of the figure should cause the bullets to strike in the centre of the band vertically above. Guns should, however, be harmonized before firing. As the accuracy of the first shot of each group fired by a machine gun is not reliable, a wide shot will generally be found when examining a group. Instructors should bear this in mind when criticizing the results of a practice or measuring the size of a group. In single shot traversing, therefore, the elevation may differ slightly from that required when firing groups.

In the Classification Practices of Part II fire will be stopped as soon as the time

limit is reached. No allowance will be made in these Practices for stoppages which are due to causes other than defects of the mechanism or breakages. The firer will be given time to look over the gun and the ammunition belt before each practice is begun.

Should the stoppage be due to a defect in the mechanism or to a breakage, sufficient time to remedy such stoppage will be allowed, or the practice will be repeated.

Points will be allotted in the Classification Practices (9, 10) as follows:

Practice 9.		Points.
75 per cent. of hits and over		35
60 " " less than 75 per cent.		30
45 " " " 60 " "		25
30 " " " 45 " "		15
15 " " " 30 " "		5
Less than 15 " "		0

		Practice 10. (Points)
No spaces (greater than 20 inches)		45
Not exceeding 2 spaces missed		40
" " 4 " " "		30
" " 6 " " "		15
" " 8 " " "		5
Exceeding 8 " " "		0

### Classification.

In order to be classified as a "1st Class" Gunner, 50 points must be obtained in the Classification Practices.

In order to be classified as a "Qualified" Gunner, 25 points must be obtained in the Classification Practices.

Those who obtain less than 25 points will be classified as "Inefficient," and should generally be replaced in the Machine Gun Section.

## AMPLIFIED NOTES ON PART I, M.G. COURSE.

1. The whole of Part I is instructional, and no records need be kept, other than the number of rounds expended.

2. The section officer should invariably be present when Part I is being fired by his section.

3. Since Part I is instructional, no time limit is imposed.

4. The section officer may repeat any practice he thinks necessary. He can save ammunition by reducing the number of rounds fired in any practice by a trained machine gunner, who proves himself to be a thoroughly efficient firer.

5. In regiments and battalions, Part I should not be begun until men are thoroughly trained in Immediate Action and have passed the Tests of Elementary Training.

6. The traversing clamp should always be sticky.

7. General points regarding *Methods of Instruction*, except for "Swinging Traverse" practice.

- (a) The instructor should generally watch the firer, order him to cease fire from time to time and examine the target

from the gun position. Having made any necessary criticism, the practice should be continued, and when it is finished further criticism should be made *at* the target.

- (b) It is important that a firer should be taught self-reliance in Part I and whenever the gun is fired. He should therefore be given the opportunity of carrying out the points before, during, and after firing, as well as of remedying any stoppages that may occur, without any assistance. Only when he has failed to carry out any of these points or has shown himself unable to deal with a stoppage should the instructor remind or assist him.

- (c) No. 2 should invariably hold up his hand to indicate that No. 1 is ready to fire, and should await the order or signal of the instructor or superintending officer before telling No. 1 to open fire.

### 8. Points regarding Range Discipline.

- (a) Never allow anyone in front of the bracket until guns are reported clear by No. 1.

- (b) Before going to the target, the lock to be raised above the guides.

9. All points before, during, and after firing must be carefully attended to, and no

slackness must be allowed in any point of elementary training.

#### 10. Part I.

*Practice I.* Grouping 10 rounds in two groups of 5. It should be remembered, when criticizing a group, that the first round is not reliable, because when it is fired the barrel is not vibrating, and therefore it bears an inconstant relation to the remainder of the group; this, however, is not always noticeable.

This practice teaches and shows the following:

- (a) The condition of the barrel and tripod.
- (b) Any peculiarities of the mechanism.
- (c) The holding required for the gun.
- (d) The sighting of the gun.
- (e) The adjustment of the fusee spring necessary to obtain the proper rate of fire.

*Method of conducting the practice.* The instructor watches the firer to see if he holds correctly and presses the thumb piece without pushing the gun forward or pulling it off the mark.

*Criticism.* The holding should be criticized both at the gun position and when at the target with reference to the group.

*Practice II.* Single shot traversing. Fired 5 rounds from right to left, and 5 from left to right, or both one after the other, at the

discretion of the section officer and provided there is sufficient ammunition. Single shot loading must be explained.

*Method of conducting and criticism.* After 2 or 3 shots, stop the firing and examine the target from the gun position. Criticize the strength of tap with reference to the lateral interval between shots, but ignore elevation, because the practice is to teach tapping and not application.

*Practice III.* Searching. *Method of conducting and criticism.* Stop the firing after 2 or 3 shots and criticize before continuing the practice. The shots should show no marked lateral dispersion, as this would probably be due to side pressure on the handles, perhaps caused by the firer keeping one hand on the wheel and pressing the thumb piece with the other.

*Practice IV.* Application 20 rounds. Two series of two groups of 5 rounds. *Method of conducting and criticism.* Watch the firer, but glance occasionally at the target and check the laying if considered necessary. There should be no unnecessary delay in loading, laying, and firing. Practice I should guide the firer as to the elevation. At the target, accurate laying and correct elevation should be points for criticism.

*\*Practice V.* Horizontal traversing. Fire is applied from observation; the tangent sight may with advantage be lowered. The firer

\* Omitted from General Machine Gun Course.

should stop firing when the end of the traverse ordered has been reached. Remind the firer that the method of altering the slide is too slow for practical service traversing, and that in Practice IV he learnt the quicker method of using the wheel for slight corrections of elevation.

**Criticism.** Each group should be of the correct volume, i.e., of 5 or 6 shots. The firer should be discouraged from using the sights, as he should, by this time, be able to tap automatically and correctly.

At the target, the following points should be discussed : (a) Good application, which includes the area of the group, the volume and the correct elevation ; (b) the spaces between groups.

## ADVANCED DRILL

The Company is supposed to have been thoroughly trained on the barrack square, i.e., Tests of Elementary Training passed, and thorough knowledge of mechanism.

The following stages of Advanced Drill are suggested as guides, with the object of ensuring that all the numbers are well trained in all the duties before they fire ball ammunition on the field firing area.

### 1. COMBINED DRILL.

The guns, tripods, etc., of one or more sections will be placed on the ground in line (as for elementary drill). Five or six paces between guns. The barrel casings will be filled with water, and the condenser bags will also contain water. The subsections will be told off as in elementary drill, but on the command "*Take Post*" each number will double off to his place and lie down.

No. 3 will take up a covered position to the rear and flank.

The whole of the gun teams will work under one commander, and practice should be afforded in the following :—

- (a) Rapidly coming into "*Action*."
- (b) Passing orders.
- (c) Use of combined sights.

- (d) Recognition of targets.
- (e) Rectification of stoppages.
- (f) Replacement of casualties.
- (g) Machine gun signals.
- (h) Ammunition supply.
- (i) Bringing up and attaching condenser.

In addition to above, combined drill should increase proficiency in elementary drill and foster competition between teams.

## 2. ROUGH GROUND DRILL.

This is to train the gunner in mounting and firing his gun on uneven ground and steep slopes.

The instructor will select a spot on rough ground or a steep slope and instruct his squad in firing down, up and horizontally along it.

The following points should be emphasised :

- (a) Correct setting up of tripod, rear leg always downhill.
- (b) Positions adopted by Nos. 1 and 2 (fire effect, exposure, steadiness).
- (c) Position of ammunition box to ensure correct feeding.
- (d) Gun properly "in action"—all details of elementary training observed.

When the squad are proficient in all the above, the following should be introduced and practised :—

- (a) Methods of approach to gun position

from a position of readiness about 50 yards away.

- (b) Positions of Nos. 3 and 4 (minimum exposure with facility for supply).

## 3. USE OF AUXILIARY TRIPOD.

This mounting is not intended to replace the Mark IV tripod. The gun can be placed on the Mark IV tripod in the ordinary manner without removing the light tripod.

The light tripod is intended for use in :—

- (a) Rapid advances.
- (b) Trench to trench rushes.
- (c) In the firing line.
- (d) Fighting in captured trenches when hurried changes of position are essential, etc.
- (e) In trench fighting, when the gun has to be fired hurriedly from an emplacement other than the battle emplacement, or when the Mark IV tripod has been destroyed. If necessary, when a suitable time arrives the Mark IV tripod can be brought up and the gun mounted on it.

The gun can be carried by either one or two men, as desired. The two carrying handles, on the rear cross-piece and on the band of the front clip, enable Nos. 1 and 2 to carry the gun between them. They should move in single file, thus concealing the gun from the front. In this way the fact that a machine gun is being brought

up would be more easily concealed from the enemy.

When it is desirable to have the gun carried by one man, Nos. 1 and 2 should move extended to about two or three paces, No. 1 carrying the gun and No. 2 two or more belt boxes of ammunition.

**Drill with "Two Man" Load** (Auxiliary Tripod).—The gun, with tripod attached, legs closed and engaged in the clip, will be placed on the ground 20 yards in the rear of the selected position upon which the gun is to be brought into action.

Muzzle of the gun to the front.

Nos. 1 and 2, each with an ammunition belt box containing a few dummy cartridges at the end of the belt, will assume the prone position, No. 1 behind the rear cross-piece, No. 2 on the right of the gun. No. 2 will have also a short length of a belt with two dummy cartridges in its leading end.

**On the Caution "Prepare to Advance,"**  
No. 1 will:—

- (a) Pull back the sliding shutter.
- (b) Pull back the crank handle on to the roller,
- (c) Seize the end of the metal belt inserted in the feed block by No. 2 and perform the first half of the loading motion.
- (d) Throw the remaining portion of the belt over the feed block to the left.

- (e) Release the lock spring.
- (f) Turn the gun on its left side.

No. 2 will insert the belt in the feed block, adjust front strap and open tripod legs.

**On the Command "Action,"** the numbers spring to their feet. No. 1 seizes the strap on the rear cross piece with his right hand, No. 2 the strap on the barrel casing with his left hand, each carrying a belt box in their disengaged hand, and move at top speed to the position selected to come into action.

**On Arrival at the Position,**

(a) No. 1 gives the order "Action," and lies down beside the gun.

(b) Throws the spare end of the belt over to the right, completes the loading motions and opens fire.

No. 2 turns down the front leather strap, lies down to support No. 1, then opens the belt box and holds the new belt ready for insertion in the feed block.

**Notes.** (i) For drill purposes about 3 seconds after No. 1 has opened fire he should perform half the unloading motion, thus allowing the belt to be pulled through the feed block and the new belt inserted.

- (ii) The fixed sight is invariably used
- (iii) Stoppages should be practised.
- (iv) Use of ground insisted upon.

On the command or signal "*Cease Fire*," followed by the caution "*Prepare to Advance*," No. 1 will unload, No. 2 removes the web belt, and inserts a short length of belt; No. 1 will then perform half the loading motions.

**Drill with "Single Load."**—The gun with tripod attached will be placed on the ground with Nos. 1 and 2 in position as previously described, except that No. 2 will have the belt boxes.

**On the Caution "Prepare to Advance,"** the numbers will act as described in "Two Man" load.

**On the Command "Action,"** the numbers spring to their feet. No. 1 lifts the gun, and, carrying it in such a manner as to hide its identity as much as possible, moves at top speed to the new position. No. 2, carrying two or more belt boxes, doubles out to the right to about two or three paces interval from the line of advance of No. 1 and moves at top speed to the new position. On reaching this he closes in on No. 1, the numbers then proceeding as for "Two Man" load.

#### 4. TRENCH DRILL.

The objects in view during trench drill are briefly:—

- (a) Relieving teams.
- (b) Relieving sentries.

(c) Standing to arms.

(d) Action.

**Relief of Teams.**—On marching into the trench, the relieving team commander will order the gunner to inspect the gun, ammunition, spare parts, etc. The gunner will report when the points to be attended to before firing, etc., have been complied with. The remainder of the team will be shown all dug-outs, look-out posts and emplacements; trench stores, spades, braziers, hyposulphite solution, etc. The gunner detailed to take over the gun, etc., will be relieved as soon as possible and made acquainted with the points mentioned above.

The sentry of the outgoing team will now be relieved and the old team march off.

**Relief of Sentries.**—No. 1 will take up position as sentry, with periscope, or at loophole if no periscope is available. The team commander will show the relieving sentry all emplacements, acquaint him and explain the points shown on the range cards. Special orders for each emplacement will be emphasised. He will also point out the ground the sentry is to watch. The relieving sentry will inspect the gun and ensure that the mechanism is working smoothly.

When the above duties have been performed the relief will be carried out, the relieving sentry ascertaining the following facts:—

(a) Whether the gun has been fired during the last relief.

(b) If fired, what the target was, and from which emplacement.

**"Stand to Arms."**—The tripod is placed in the battle emplacement, the gun in carrying bag, waterproof sheet or sandbag, and ammunition will be placed in dug-out. No. 1 will be on sentry, Nos. 2 and 3 in the dug-out.

On the command "*Stand To*," No. 1 will run to the dug-out (wake Nos. 2 and 3, if asleep), take the gun and mount it in the battle emplacement, No. 2 following with the ammunition and spare parts case. No. 3 remains in the dug-out in readiness to perform his duties.

**Action.**—The position of readiness will be as for "*Stand to Arms*." On the command "*Name (or number) of emplacement aiming mark—Action*,"

The sentry runs to the dug-out and repeats the order.

No. 1 takes the gun to the emplacement ordered, closely followed by No. 2 carrying ammunition and spare parts case. On arrival at the emplacement No. 1 will mount the gun on the tripod if in position, otherwise the auxiliary tripod will be used.

The gunner then loads, lays the gun on the mark and awaits further orders.

## 5. LIMBER DRILL.

### 1. Packing Limbers.

#### A. No. 1.—Gun Limber (Fore Portion).—

The following stores will be dumped in rear of the limber :—

- 2 bags, Trench Machine Gun.
- 2 guns (Vickers), with cleaning rod and spare barrel in boxes.
- 2 mountings, Mark IV.
- 14 belts, ammunition, in boxes.
- 2 spare parts boxes, complete with first-aid cases inside.
- 8 cans, oil, in 2 leather cases.
- 2 condensers, with tubes.
- 2 auxiliary tripod mountings, complete.
- 4 packs, filled (Nos. 1 and drivers).

**Fall In.**—The sub-section (excluding drivers) will fall in as for inspection immediately in rear of limber.

**On the Command "Pack Limbers,"** the Nos. 1 and 2 double to the dump, take 3 belt boxes each, and place 6 on each side of limber, upright, side of box touching side of limber, arrowhead pointing inwards.

Immediately belt boxes are in position the Nos. 3 and 4 place the gun boxes on top, one on either side of limber, hinges towards the sides of limber.

The Nos. 1 will then follow with the Mark IV tripods and condensers, placing the

tripods in the centre of the limber, crossheads touching the tailboard, and as close to each other as possible. The condensers (bag and tube separately) to be fitted in between the tripods and gun boxes.

The No. 2 of right gun team will bring up 2 spare parts boxes and place them in the front end of limber slightly to the off side, hinge to the rear.

At the same time No. 2 of left gun team will bring up 2 belt boxes and place one on each side of limber, next to the middle belt box on the floor of limber.

No. 3 of right gun team now packs the 2 cases, cans, in space on near side against spare parts boxes: at the same time No. 3 of left gun team packs 2 auxiliary tripods on floor space to the rear of spare parts boxes.

The Nos. 4 now pack the 2 Bags, Trench Machine Gun between Mark IV tripods and gun boxes, the Nos. 1 and 2 following with 4 packs, which are placed in the space in centre of limber.

All numbers, 1 to 4 (the right gun team on the off side, and the left gun team on the near side), place the cover on limber.

NOTE—To enable this drill to be carried out 4 brackets are screwed to the front and tailboard of the wagon, and serve as supports for the ends of the gun boxes, which lie horizontally and lengthways in the wagon. The bottoms of the boxes should be suffi-

ciently high above the floor of the wagon to allow belt boxes to be slipped in underneath them. The gun boxes are secured by pressing their rope handles down between their cleats and the ends of the wagon.

**B. No. 1.—Gun Limber (Hind Portion).—**

The following stores will be dumped in rear of the limber:—

2000 cartridges S.A.A. ball '303.

1 drum, oil, containing water.

12 belts ammunition in boxes placed in 4 pack carriers.

2 belts ammunition in boxes placed in metal carriers.

1 valise, shoes, mule.

4 horse rugs.

1 bag line gear.

2 buckets, water.

1 saw, folding.

1 pistol signal.

20 sandbags.

2 picks.

1 felling axe.

2 bill hooks.

1 mallet.

2 shovels.

4 hay nets.

7 packs filled (Nos. 2, 3, and 4, both gun teams, and section officer's).

2 hammer-headed axes.

**On the Command "Pack Limber,"** one No. 5 will place the water drum and hay nets in front off corner, hay nets on top of drum. The other No. 5 places the 4 horse rugs touching the drum and touching the front end of the hind portion of limber.

One No. 6 will bring up the pistol signal, folding saw, and bag line gear (filled with mallet heel peg, and pins, picketing, etc.), placing the bag in front near corner, the pistol to be laid on top of 4 horse rugs, muzzle touching water drum, the folding saw next to the 4 horse rugs.

At the same time the other No. 6 will place one pack carrier lengthways on near side of limber, touching the bag line gear, lids to be against near side of limber.

The scout (S) will place one pack carrier on the near side against the one already packed, at the same time the range-taker (R) will place the two metal carriers flat, and as far forward as possible, touching water drum and horse rugs.

The Nos. 5 now place two pack carriers as far forward as possible, ends touching off side of limber.

The Nos. 6 will each pack one S.A.A. box, on end at the rear of limber, one on each side.

S and R will now pack tools on floor space, heads to the rear.

One No. 5 will pack sandbags on top of the horse rugs, and two buckets on top of line

gear bag. The other No. 5 will place the valise, shoes, against S.A.A. box on off side.

One No. 6 will next pack two packs in centre of limber.

S and R will bring up the remaining packs while Nos 6 pack them.

Nos. 5 and 6 of each team replace covers on limber. Left gun team on left of limber, right gun team on right of limber.

## 2. Drill with Limbers.

### Prepare for Action.

**On the Command or Signal "Prepare for Action,"** the gun teams double to the limber (right team on off side, left team on near side), and remove covers from limber.

The Nos. 4 having removed the 2 bags, trench machine gun, and packs, the Nos. 1 remove tripods and condenser tubes from limber, double out to a position indicated by the section officer and lie down.

At the same time the Nos. 3 remove 3 belt boxes and spare parts boxes from limber, they will then open the S.P. boxes and take out the first-aid cases. Each No. 3 will hang the first-aid case round the neck of his No. 2.

The Nos. 2 and 3 now remove the guns and oil cans from limber, oil guns for action, and Nos. 2, having received first-aid cases from their Nos. 3, will double out to a position near their Nos. 1. They will then screw on

the condenser tubes and prepare the guns for action with the aid of the Nos. 1.

The Nos. 3, having returned S.P. boxes to limber, will double into position with 2 belt boxes taken from limber.

Each No. 4 now removes from limber 2 belt boxes and the condenser bag, half filling the latter with water from drum in hind portion of limber.

Nos. 5 each take 2 belt boxes, and lie down under cover.

The corporal then moves limber to cover, Nos. 6 accompanying him.

### Out of Action.

**On the Command or Signal "Out of Action,"** the corporal and Nos. 6 move the limber up to the most convenient position for the guns coming out of action, consistent with the safety of the mules.

The Nos. 4's and 5's now repack belt boxes under gun boxes, open gun boxes, and tidy limber.

The Nos. 3 also repack belt boxes under gun boxes, and prepare to replace first-aid cases in S.P. cases.

The Nos. 2's and 3's then replace guns in boxes, close lids, and Nos. 2 hand first-aid cases to the Nos. 3 to replace in S.P. boxes in limber.

The Nos. 4 take the condenser, etc., off guns as soon as the Nos. 2 arrive with them, empty water into drum again, and repack condensers and tubes in limber.

The Nos. 1 replace the tripods in limber.

All numbers (the right gun team on the off side and the left gun team on the near side) replace the covers on limber.

## CHARACTERISTICS OF THE MACHINE GUN.

1. The tactical handling of a machine gun, like any other weapon, must depend upon its characteristics.

In character, the machine gun resembles the rifle, both in calibre and range; but it possesses an artillery adjunct in the shape of a fixed mounting, or platform. This fixed platform decides the character and scope of the gun, and separates its functions sharply from those of the Lewis gun.

The characteristics of the machine gun are :—

- I. Fixed platform.
- II. Rapid production of a large volume of fire.
- III. Narrow front and shallow depth.
- IV. All-round traverse.
- V. Invulnerability.
- VI. Mobility.
- VII. Liability to accidental cessation of fire.
- VIII. Noise; flash; steam; oil-vapour.

**I. Fixed Platform.**—The essential properties of a fixed platform are as follows :—

1. It reduces the *personal* factor. That is, correct direction and elevation are obtained, and (more especially) maintained by *mechani-*

*cal* means, so cannot vary (as in rifle shooting) with the skill or temperament of the firer.

2. The gun being held rigidly, the bullets are grouped very closely together, with powerful *boring* effect.

*From these two facts we draw the following deductions :—*

(a) Machine gun fire is as steady under war conditions as under peace conditions. A fixed platform minimises the effect of "nerves."

(b) For the same reason a machine gun is a particularly valuable weapon in a sudden emergency or crisis.

(c) A machine gun can fire as accurately by night as by day.

(d) A machine gun's close grouping and freedom from human shortcomings enable it to be fired with safety over the heads of friendly troops.

(e) Its close grouping, causing a large number of bullets to strike upon the same spot, makes observation of fire practicable. This fact is of enormous value in obtaining the correct range to a target.

On the other hand—

(f) Close grouping necessitates very accurate ranging. Roughly speaking, a machine gun's shots must either all hit or all miss. There is no average of dispersion, as in rifle fire.

(g) For the same reason, machine gun fire will be wasted against a shallow target, unless it is realised that a machine gun is essentially an *enfilading* weapon, and can only be advantageously employed where its boring effect can be exercised :—

- (i) Firing to its front—*along defiles or streets, upon troops advancing in depth.*
- (ii) Firing obliquely, or from a flank—*upon troops advancing in shallow formation.*

**II. Rapid Production of a Large Volume of Fire.**—A machine gun, once mounted and loaded, can open an intense, accurate, and sustained fire at any moment.

*From this fact we draw the following deductions :—*

(a) Owing to its intensity and accuracy the *fire-power* of a machine gun is far superior to that of a body of infantry expending an equal number of rounds per minute. Actual experience has demonstrated that this fire-power is at least equivalent to that of a hundred men with rifles.

(b) A machine gun is particularly suited to surprise effect.

(c) A machine gun is a most valuable adjunct to outpost work, especially at night.

**III. Narrow Front and Shallow Depth.**—The maximum space required for a machine gun is 6 feet square.

*From this fact we draw the following deductions :—*

(a) A machine gun is of great value in a cramped locality, where there is no room for riflemen to act with effect, *e.g.*, for firing from a single window or down a narrow street.

(b) A machine gun can take advantage of small, or isolated cover, *e.g.*, a shell-hole.

(c) A machine gun can be brought into action less conspicuously than a body of troops, and is very difficult to locate when in action.

*Example.*—A machine gun could be brought into a field of standing corn, or of corn-stooks, without attracting attention. Once placed, it would be almost impossible for the enemy to locate the gun's exact position, except by a systematic "beat."

**IV. All-round Traverse.**—The gun can be turned quickly in any direction.

*From this fact we make the following deduction :—*

An ideal position for a machine gun is on a flank or detached post.

**V. Invulnerability.**—No weapon is absolutely invulnerable; but a machine gun, which possesses fire-power equivalent to that of *one hundred men with rifles*, requires only *two men* to serve it.

*From this fact we can draw the following deductions :—*

(a) A machine gun and its team present such a small target to the enemy as to be almost invulnerable to any but concentrated artillery fire, or specially detailed sharpshooters.

(b) This invulnerability can be greatly increased by skilful use of ground and cover. It is nearly always possible to find concealment for a single machine gun.

(c) It is likely that the gun will frequently escape injury when the men do not; therefore all gun numbers must be capable of performing the duties of Nos. 1 and 2.

(d) No more men must be with the gun than are necessary.

(e) There should be reserves of trained men to replace casualties after action.

**VI. Mobility.**—Mobility is a question of *degree*. Consideration of the mobility of any arm is useless unless it is compared with the respective mobility of other arms.

It will be convenient to compare the mobility of a machine gun section (four guns) with that of an equivalent number of rifles (400).

(A) When *not under fire*.

(B) When *under fire*.

(A) A machine gun section, when not under fire (that is, when the guns are on the limbers), is *more* mobile than an equivalent body of infantry.

*From this fact we can draw the following deduction:—*

Machine guns form a valuable reserve of fire-power in the hands of the Brigadier.

(B) A machine gun section (or single machine gun), when under fire, is *less* mobile than infantry.

*From this fact we can draw the following deductions:—*

(a) The mobility of machine guns depends upon their ability to utilise their *transport*. Therefore limbers (or, failing limbers, pack animals) should be brought as near to the fire-position as is compatible with the safety of the animals.

(b) Once in action, machine guns should not be moved about except—

(i) To give *close* support.

(ii) To consolidate positions.

(iii) To avoid shell-fire. (Very often 50 yards to right or left is quite sufficient.)

On the other hand, machine guns possess certain adverse characteristics, namely:—

**VII. Accidental Cessation of Fire (Stoppages).**—These stoppages may be:—

(i) Mechanical.

(ii) Due to want of care.

The possibility of stoppages of *any* kind may be reduced to a minimum by:—

(a) Systematic care and cleaning of the gun.

(b) Thorough training in "immediate action."

(c) Complete familiarity with the appearance and use of all the spare parts.

(d) A highly trained No. 3, whose duty it is to execute small repairs on the gun.

### VIII. Noise ; Flash ; Steam ; Oil-Vapour.—

(a) NOISE.—*The presence of a machine gun is betrayed by its characteristic noise, but owing to the illusion of the senses produced by the overlapping sounds of the gun's report and the passage of the bullet overhead (claquement) it is extremely difficult to locate the gun's exact position.*

(b) FLASH.—The flash of the gun is most conspicuous at night and in dull weather. This danger can be minimized—

(i) By the use of flash-concealers.

(ii) By firing through a screen of wet sandbags.

Or,

(iii) By judicious use of alternative positions.

(c) STEAM.—After about 600 rounds of continuous (or 2,000 intermittent) firing, the water in the barrel-casing boils furiously, and a jet of steam is produced, which is very apt

to reveal the position of the gun. This difficulty can be overcome entirely by the timely employment and proper fitting of the condenser.

(d) OIL-VAPOUR.—If the gun is fired in an oily condition, the result is a volume of smoky vapour.

*The barrel and muzzle attachment must be wiped free from oil before firing.* Too often an excellent position and a well-concealed loophole have been given away by the first few rounds fired from an oily barrel.

### Summary of the Characteristics of the Machine Gun.

1. Its fire-power is equal to that of 100 rifles at least. Its primary effect, therefore, is that of very concentrated infantry fire, to extract the full benefit of which *oblique fire* is necessary.

2. In addition to this, its fixed platform renders it eminently suitable for overhead, night, and long-range searching fire.

3. Its frontage being that of two men, it is a most difficult weapon to locate or put out of action.

4. Owing to its invisibility, it is extremely valuable for surprise tactics.

The machine gun, owing to the disproportionate quantity of ammunition which it consumes and the consequent difficulty of maintaining an adequate supply, has been

styled a weapon of *opportunity*, implying that it should only be employed when a really profitable opportunity presents itself. The word "opportunity" is liable to misinterpretation unless it is taken in the following sense :—

- (i) Opportunities come, not to the man who waits for them, but to the man who seeks them. In this case, to the man who makes the utmost use of ground in order to obtain good targets.
- (ii) Opportunities are an affair of the moment : they must be seized at once. This particularly applies to machine gun targets, which are of the "disappearing" type.

In other words, the machine gunner *creates his own opportunities*, and then acts upon them immediately.

## FIRE DIRECTION.

The term "Fire Direction" is used to indicate the duties of machine gun commanders which ensure that the fire from their guns is applied to the best tactical advantage.

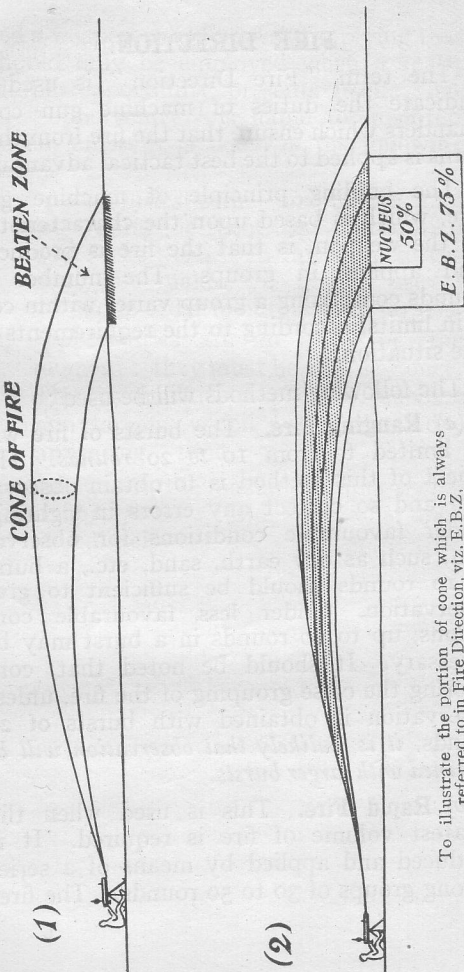
The guiding principle of machine gun fire, which is based upon the characteristics of the weapon, is that the fire is produced and applied in groups. The number of rounds comprising a group varies within certain limits, according to the requirements of the situation.

The following methods will be used :

(a) **Ranging Fire.** The bursts of fire will be limited to from 10 to 20 rounds. The object of this method is to obtain observation and so correct any errors in sighting. Under favourable conditions for observation, such as dry earth, sand, etc., a burst of 10 rounds should be sufficient to give observation. Under less favourable conditions, up to 20 rounds in a burst may be necessary. It should be noted that, considering the close grouping of the fire, unless observation is obtained with bursts of 20 rounds, *it is unlikely that observation will be obtained with larger bursts.*

(b) **Rapid Fire.** This is used when the greatest volume of fire is required. It is produced and applied by means of a series of long groups of 30 to 50 rounds. The firer

ILLUSTRATING CONES OF FIRE.



pauses momentarily between each group to ensure that the sights are correctly aligned, and continues until ordered to cease, or until he considers it necessary to do so. Rapid fire will be used (1) when the sighting elevation has been successfully obtained by ranging fire; (2) when surprise effect is required; (3) with combined sights.

(c) **Traversing Fire.** This method of distributing fire laterally is employed against a linear target and is applied by means of a series of small groups with the object of covering as wide a front as possible with only sufficient volume to ensure effect. In this case a group should consist of from 5 to 10 rounds only, because against a linear target greater volume will not produce greater effect.

Up to 1,000 yards, experiments show that machine guns firing 250 rounds in one minute can distribute annihilating fire (i.e. without any lateral gaps greater than 1' 6" between shots) over 25 yards of front. This will form the basis of calculations as to whether any particular line is sufficiently dense to repay the expenditure on it as regards material effect, and apart from any tactical necessity there may be to engage it. This is also the basis for calculating the number of guns required to defend any frontage, or to engage any target in a given time.

Machine guns can engage lines to greater

advantage from an oblique direction, as the spaces between figures are closed up the further to a flank the gun position may be. At an angle of 45 deg., experiments show that increase in effect of at least 30 per cent. may be expected.

(d) **Swinging Traverse.** For trench warfare, and against dense targets *at close range*, the "Swinging Traverse" has been found necessary. It in no way replaces the method of traversing by automatic tapping, which should still be considered the normal method.

Single, deliberate shots are of no value for ranging, as, owing to the gun then being perfectly steady, these shots bear no relation to the subsequent rapid grouping. The same generally applies to the first shot of every group.

From the foregoing paragraphs it will be seen that fire direction may be divided into two main headings:

- (i) Allowance for error of day.
- (ii) Allowance for error in ranging by artificial dispersion in depth.

**Allowance for error of day, i.e. :—**

(1) Judging the effect of atmosphere on the elevation required.

(2) Judging the effect of wind on the flight of the bullet.

These may be briefly tabulated as follows :

Barometer : Pressure of Air.

Thermometer : Density of Air.

Wind : Front and Rear.

Light : Difficulty or ease in focussing on "Dull or bright day."

It will be noted that these influences affect the bullet in a vertical sense, and for simplicity may be again tabulated as follows :—

### ERROR OF THE DAY.

#### ELEVATION TABLE.

<u>More.</u>	<u>Less.</u>
Dry.	Wet.
Cold.	Hot.
Head Wind.	Rear Wind.
Bright.	Dull.

For Table of Allowances see Card in pocket of this book.

So far we have dealt only with those weather conditions which affect the bullet in a vertical sense. We will now consider how the bullet may be affected in a horizontal manner.

### FOR SIDE WINDS.

The Wind Table given in Para. 638 M.R. should be thoroughly learned by all Section Officers.

This is necessary so that commanders may

estimate the strength of the wind blowing, and convert it to some measurement which can be understood by the gunners.

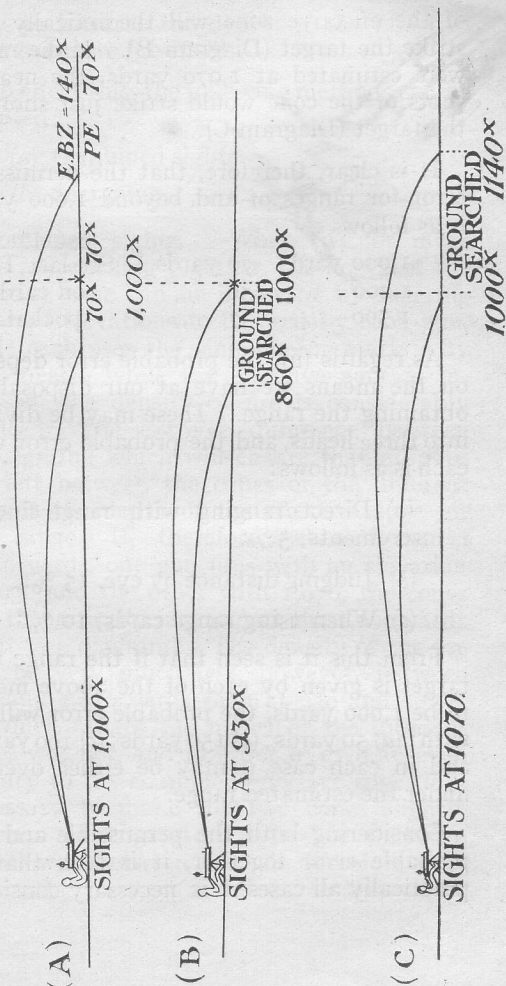
The Wind Table referred to will be found on the card in the pocket of this book.

When issuing deflection orders for narrow-fronted targets, an auxiliary aiming mark should be given when possible. To order the gunner to aim off in target widths is the next best method. Orders to aim off in feet or yards should be avoided.

*Allowance for error in ranging by artificial dispersion in depth.* Owing to probable errors in ranging, difficulty in estimating the error of the day at long ranges, and to the close grouping of the machine gun, it becomes necessary to increase the depth of the beaten zone to give assurance of obtaining fire effect. The amount by which the beaten zone has to be increased depends on (i) the permissible error in ranging, and (ii) the probable error in ranging.

As regards (i), it will be clear from the diagrams that if we make an error in ranging which is greater than half the depth of the effective zone, the target will not be included in this zone, and fire will be ineffective. For example, if the correct range to the target is 1,000 yards, but is estimated to be 930 yards, the furthest shots

TO ILLUSTRATE PERMISSIBLE ERROR IN RANGING.



of the effective zone will theoretically just strike the target (Diagram B). If the range were estimated at 1,070 yards, the nearest shots of the cone would strike just short of the target (Diagram C).

It is clear, therefore, that the permissible error for ranges of and beyond 1,000 yards is as follows :

1,000 yards	70 yards.	} See last Table on card in pocket.
1,200 "	56 "	
1,500 "	37 "	

As regards (ii), the probable error depends on the means we have at our disposal for obtaining the range. These may be divided into three heads, and the probable error with each is as follows :

(a) Direct ranging with range finding instruments, 5 %.

(b) Judging distance by eye, 15 %.

(c) When using range cards, 10 %.

From this it is seen that if the range to a target is given by each of the above means to be 1,000 yards, the probable error will be, with: (a) 50 yards; (b) 150 yards; (c) 100 yards; and in each case it may be either over or under the estimated range.

Considering both the permissible and the probable error together, it is seen that in practically all cases it is necessary consider-

ably to increase the depth of the effective zone to ensure fire effect.

To effect this, the following methods can be adopted:

(a) Combined sights.

(b) Searching.

**Combined sights.** When two or more guns are working together, the depth of the effective zone can be increased by ordering different elevations to be used by each gun, while each uses the same aiming mark. By this means, while the effective zone is increased, the density of fire is considerably reduced. The extreme difference between the sighting which will ensure that no gaps are left between the cones of the different guns is the depth of the effective zone for the range. If, therefore, when firing at 1,000 yards, one gun fires with an elevation of 930 and the other with 1,070, the cones will theoretically just join at the 1,000 yards point (see diagram). The density of the fire will be very much less, however, between 990 and 1,010 yards than at 930 and 1,070, at which ranges the nuclei of the different cones will fall, and in order to give an even density to the combined effective zone it is necessary to make the two cones slightly overlap. The greatest difference that can be allowed between guns is therefore only 100 yards.

The difference of sighting used depends on the number of guns available and also the probable error in ranging. In order to find the depth of the combined effective zone, the following method is useful:

Multiply the number of guns available less 1 by the difference in sighting used, and add the effective zone of one gun, e.g., To find the depth of combined effective zone at 1,200 yards when four guns are available and 50 yards difference used:

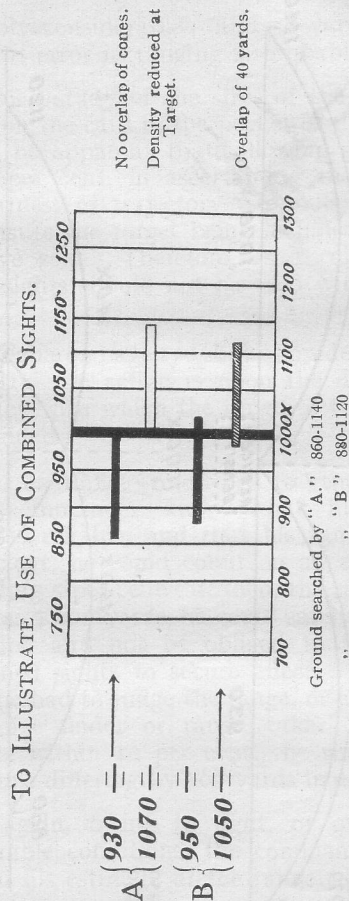
$$(4-1) \times 50 + 112 = 262 \text{ yards.}$$

Another method is to divide the ground to be searched by the differences in elevation allowed. For example:—

If 300 yards of ground is to be searched at 1,000 yards range, where the differences of sighting should not exceed 100 yards, we should divide 300 by 100. This gives 3 as the number of guns to be used.

Since the greater the concentration of fire the greater will the effect of fire be; therefore combined sights should not be used—or with small differences only—if accurate observation of the strike of the bullets can be obtained, unless surprise is required.

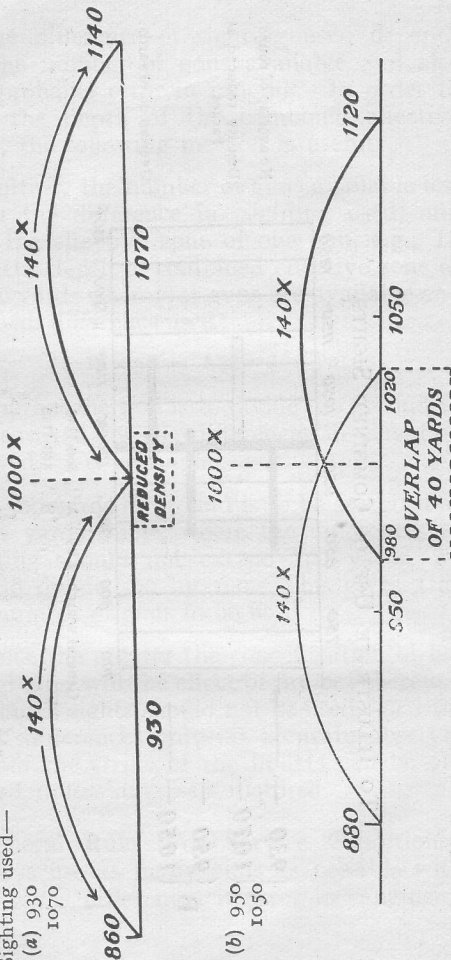
**General Rule** (For Service Conditions). Always use as many guns as possible with 100 yards differences if error in ranging is



ILLUSTRATING GROUND SEARCHED BY TWO GUNS USING COMBINED SIGHTS.

Sighting used—

(a) 930  
1070



probably considerable; and 50 yards differences if error in ranging is probably small.

From a study of the sizes of the Beaten Zones on the card in the pocket of this book it will be apparent that, allowing an error of 10 per cent. in ascertaining the range, the flatness of trajectory within 800 yards will ensure the target being included in the effective zone. Therefore, as a rule, combined sights should not be used within 800 yards.

The Table on page 170 shows how dependent successful fire action is upon the degree of accuracy with which the range to the target is obtained.

For example, referring to the table, if a commander knows that his range finder is reliable, and that his range taker is efficient, he could count on an error not exceeding 5 per cent.; if, then, the range was given as 1,000 yards, he could safely use one elevation and not be obliged to resort to combined sights to secure effect. If, however, he had to judge the range, or appraised his range finder or range taker as only reliable within 10 per cent., he should use two guns differing by 100 yards in elevation.

If, again, owing to light, or other unfavourable conditions, the commander considered his estimate of the range to be only

within 15 per cent., he would require three guns differing by 100 yards. He would probably not open fire with two guns, as success would be exceedingly doubtful, unless required to do so by the exigencies of the situation.

It may be stated for general guidance that combined sights differing by 100 yards should be used beyond 800 yards and up to 1,200 yards inclusive; beyond 1,200 yards the difference in sighting should not exceed 50 yards between guns. As will be seen from the table on p. 170, if this guiding principle is followed successful fire action can be relied upon. Under certain conditions, however, as explained above, a machine gun commander should use his judgment in modifying the application of this principle in accordance with the facilities that may be available for accurate ranging, and thus gain the tactical end in view with less expenditure of ammunition and less exposure of guns and personnel.

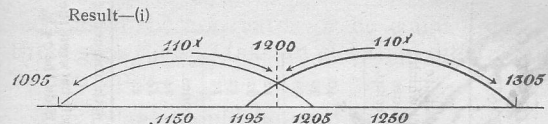
Illustrating the point that 100 yards differences will give overlap of cones up to 1,200 yards only.

Range 1200—10% Error =  $\pm 120^x$

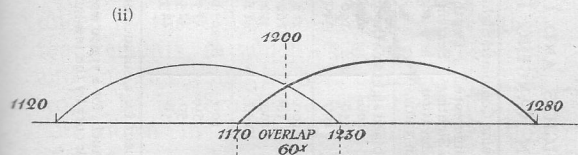
Ground to be searched  $\frac{1320}{1080}$

Two guns only available.

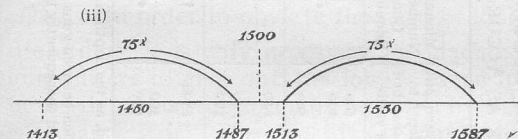
Sighting elevation ordered, 1150—100 yards differences.



Range 1200—5% Error. Sighting elevations ordered, 1175—50 yards differences.



Range 1500—10% error. Target may be between 1350 and 1650. If 1450 and 1550 is ordered, result may be as follows:—



Another question which should be left to the judgment of the machine gun commander occurs when sections are working together. In such a case differences of elevation may be given either to each gun or to each sub-section. This will depend on the tactical situation. For example, if three sub-sections are co-operating and the commander judges that ranging can be relied upon to give an error not exceeding 10 per cent., and the range is given as 1,200 yards, he can either order each sub-section to use the same elevation and the difference between sub-

TABLE SHOWING THE EFFECT OF COMBINED SIGHTS AND ILLUSTRATING THE SAVING OF FIRE POWER AS ACCURACY IN RANGING INCREASES:

Using Combined Sights.						
Range in Yards.	Depth of Effective Zone in yards.	Error in Ranging.	Consequent Depth to be searched in yards.	Minimum Number of Guns Required.	Difference in Sighting Elevation in yards.	Distance over which Cones Overlap.
1,000	140	5%	100	2	100	240
		10%	200	*2	50	190
		15%	300	3	100	340
1,400	112	5%	120	2	100	212
		10%	240	3	50	162
		15%	360	4	100	312
1,500	75	5%	150	†	100	412
		10%	300	6	50	Space between cones.
		15%	450	*8	50	175
						24
						325
						425
						24
						24

\* In these cases another gun would be required, as the depth is insufficient for assurance of effect with number of guns given.

† In these cases 100 yards difference of elevation between guns is too much, for a space would be left between the cones within which the target might be, and would consequently be struck only by the few bullets outside the 75 % i.e., the effective zone.

sections to be 100 yards or he could order three guns each to take an elevation differing by 100 yards.

The former would be used against a very favourable target, which required a large volume; the latter when the volume produced by three guns would meet the tactical requirements, in which case one sub-section and one gun would be held in reserve. This would be in accordance with the principles laid down in Infantry Training, Section 162, 12.

12. *Control of guns when using combined sights.* In order to obviate the need of long fire orders, it is only necessary for machine gun officers to give out the lowest range to be used. This will normally be taken by the left hand gun. The No. 1 of that gun will pass to the No. 1 of the gun on his right the range he *himself* is using and the differences ordered. This No. 1 in his turn will pass on his range to the gun on his right, and so on down the line. In addition, the directing officer must state the difference in sighting between guns to be used, which will also be passed down by Nos. 1.

When the target to be engaged is a narrow one, and all guns are using the same aiming mark, it will be generally impossible for the firers to observe their own particular cone of fire as distinct from the whole combined cone.

tions are made by the turn of the elevating wheel, and not by the tangent sight.

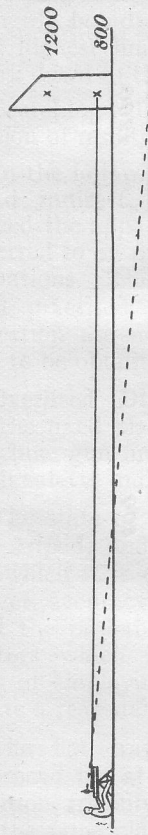
The range to the nearest point of the target is taken, sights adjusted, and gun laid on that point, or aim may be taken at any suitable mark in the area of ground to be searched. Sights are then set for the furthest point of the target to be engaged. This will throw the line of sight short of the aiming point. A burst is then fired, elevating wheel is turned sufficiently to cause the next burst to strike beyond the first, but not so far as to allow a gap or deflated zone between the two bursts.

This process is continued until the line of sight is again brought on to the aiming mark. The whole length between the near and far end of the target will then have been swept.

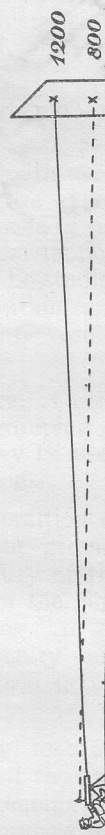
In cases where the ground rises at a fairly steep angle, the cones would not reach the further limit unless an extra 100 or 200 yards is added to the range of the further limit.

If the target is broader than the breadth of the normal cone of fire for that range, the gun should then be slightly traversed and the process reversed. The slide will in this case be brought back again to the distance of the near point of target; the line of sight will then be above aiming mark, and the elevating wheel will be turned until the line of sight is again on the aiming mark.

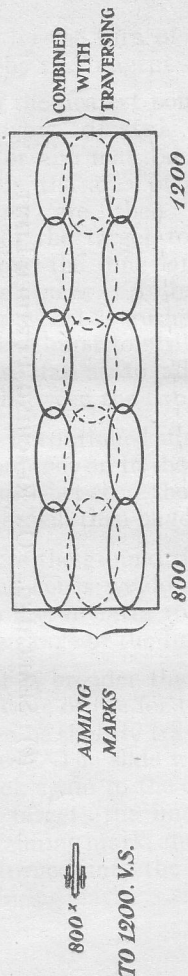
(a) SEARCHING. AT COMMENCEMENT OF PRACTICE.



(b) SEARCHING. ON REACHING FURTHER LIMIT.



SEARCHING. ENGAGING A TARGET IN ENFILADE.



When using two guns the left gun will act as described above; the sights of the right gun will be adjusted in the first instance to the highest limit to be searched, and will work down to the lowest limit.

Searching will be discontinued when observation of results is obtained.

In the following paras., dealing with overhead, indirect, and night firing, are exemplified the application of the methods of fire referred to on page 155 to particular tactical situations. These examples must be studied and practised, as skilful preparation and direction are necessary if adequate results are to be obtained on service.

**Overhead (Direct) Covering Fire.** Owing to the fixed platform and close grouping of machine gun fire, this method may be used with safety, under limited conditions.

The state of the barrel, the condition of the tripod, and the nature of the ground on which it is erected, the visibility of the target, accuracy of aim, holding of the gun, and the probable errors in ranging, are all factors which increase the difficulty and risk of employing overhead fire, and necessitate a reasonable margin of safety.

The flat trajectory necessarily restricts overhead fire at the closer ranges if the gun position, friendly troops and the enemy are on the same plane, while at long ranges the

dispersion of the cone of fire and difficulty of ranging make it dangerous.

Overhead fire, therefore, might normally be employed under the following conditions:

(a) The range to the target must be obtained accurately, that is, within 5 per cent. of error.

(b) If the range to target is 1,000 yards or under and the angles of sight to the target and friendly troops contain an angle of not less than 30 minutes.

If the range to target is between 1,000 and 1,500 yards, the angle must not be less than 60 minutes.

If the range to target is over 1,500 yards, the angle must not be less than 100 minutes.

These angles allow for a large margin of safety at the shorter, and a sufficient margin at the longer, ranges.

(c) Overhead fire must be discontinued when the friendly troops advance beyond 2,000 yards from the gun.

(d) Barrel and tripod not worn.

No. 1 a good firer.

Tripod well dug in.

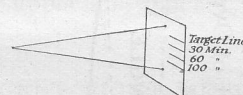
Target clearly visible.

The safety angles mentioned above may be obtained:

(a) From prismatic field glasses graticuled for Mark VII ammunition, in which

case the distance between the zero line and 600 yards graticules gives an angle of 30 minutes, that between the zero line and 1,000 yards an angle of 62 minutes, and that between the zero line and 1,300 yards an angle of 100 minutes.

(b) By the card and string method. Attach a piece of string of any convenient length to a card and use the 600 yards, the 1,000 yards, and the 1,300 yards graticules as laid down when using graticuled field glasses.

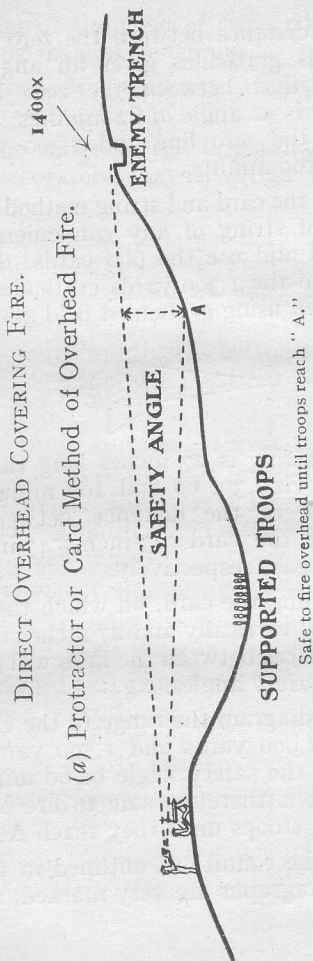


If the string is 27 inches long the angles required, viz., 30, 60 and 100 minutes, are equivalent to the distance between lines drawn on the card .23-inch, .47-inch and .75-inch apart respectively.

By holding the card, on which these lines are drawn, vertically and 27 inches from the eye the spaces between the lines will give the required safety angles, e.g. :

In this diagram the range to the enemy is between 1,000 yards and 1,500 yards, consequently the safety angle of 60 minutes is taken. It is therefore safe to fire over the supported troops until they reach A.

When the conditions outlined in the preceding paragraphs are very marked, no diffi-

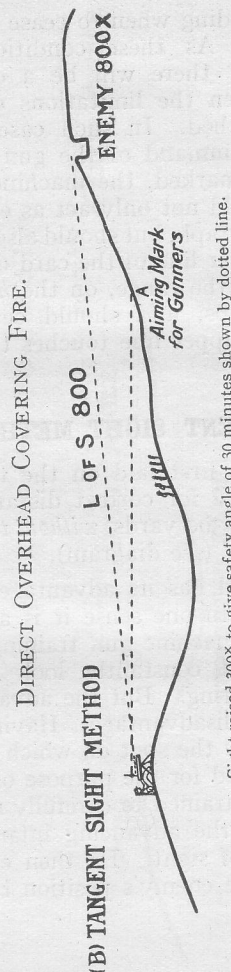


culty in deciding when to cease fire is to be anticipated. As these conditions become less marked there will be a difficulty in deciding when the limitations of overhead fire are reached. In such cases as these, when the command of the gun position is not clearly marked, the machine gun commander should not only act as explained in the last paragraph, but should also frequently place the lower line of the card or graticule, according to the range, on the *heads* of the friendly troops, and should cease fire as soon as the upper line touches the enemy's position.

### TANGENT SIGHT METHOD.

The gun is first laid on the target with sights adjusted for correct distance. Then raise the slide 300 yards, *without touching the elevating wheel* (see diagram).

This method has its advantages and disadvantages. In one sense it is against the principles of machine gun training that the gunner should constantly look along the sights while firing. But the advantages far outweigh the disadvantages. Having marked down carefully the spot on which the sights are now aligned for the purpose of relaying, the gunner is trained to carefully note when the heads of the advancing infantry come into his line of sight. He then elevates at once on to the enemy's position by turning



Sight raised 300° to give safety angle of 30 minutes shown by dotted line.

the elevating wheel. By this means covering fire is maintained until the friendly troops reach the enemy's position. The cones of fire pass over the heads of friendly troops, and search ground in rear of the defended position possibly occupied by supports and reserves.

### How the Safety Angles for Direct Overhead Fire are Obtained.

Purely as a matter of interest, and also to show that a liberal margin of safety is allowed in the angles of 30, 60 and 100 minutes referred to, the following explanation is given, showing how the angles are obtained.

(I) The factors which must be considered, and a suitable allowance made for each, viz.:

1. Vertical dispersion of lower half of 100 per cent. cone at each range.
2. The probable errors to be expected in ranging.
3. Other factors such as bad laying, incorrect holding, etc.

*The vertical dispersion of the lower half of the 100 per cent. cone is as follows:—*

At 500 yards ..	...	...	5 feet
At 800 yards ...	...	...	8 feet
At 1,000 yards ...	...	...	10 feet
At 1,500 yards ...	...	...	20 feet
At 2,000 yards ...	...	...	30 feet

This vertical dispersion expressed in angles by means of formula

$$M(\text{Minutes}) = \frac{V.I. (\text{Vertical dispersion in feet})}{H.E. (\text{distance from gun to target in ft})} \times 3,400$$

is as follows:—

At 500 yards ...	...	...	11' 0"
At 800 yards ...	...	...	11' 0"
At 1,000 yards ...	...	...	11' 0"
At 1,500 yards ...	...	...	15' 0"
At 2,000 yards ...	...	...	17' 0"

The probable errors to be expected in ranging may be taken as follows:—

Using accurate rangefinder and efficient rangetaker ...	... 5 per cent.
Allowance for remaining factors, bad holding, etc., etc....	... 10 per cent.

Total percentage of range ... 15 per cent.

This 15 per cent. at 500 yards range is 75 yards.

This 15 per cent. at 800 yards range is 120 yards.

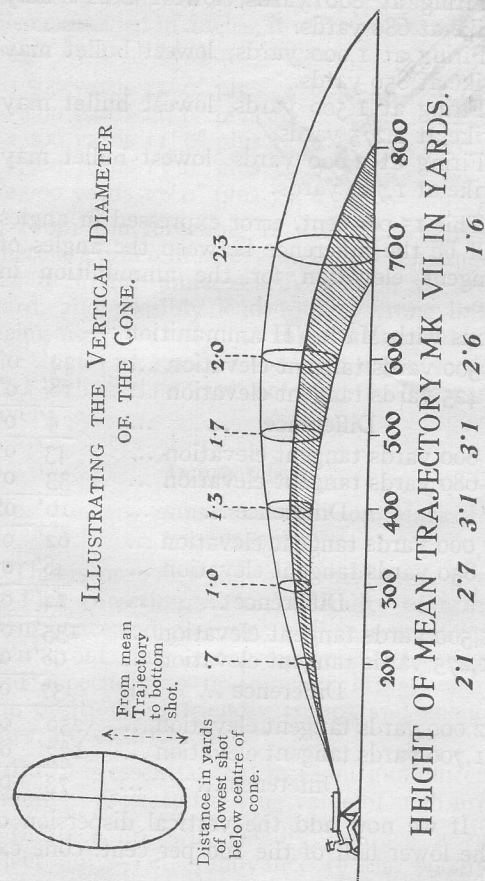
This 15 per cent. at 1,000 yards range is 150 yards.

This 15 per cent. at 1,500 yards range is 225 yards.

This 15 per cent. at 2,000 yards range is 300 yards.

In other words the lowest bullet of the 100 per cent. cone may strike as follows:—

Firing at 500 yards, lowest bullet may strike at 425 yards.



Firing at 800 yards, lowest bullet may strike at 680 yards.

Firing at 1,000 yards, lowest bullet may strike at 850 yards.

Firing at 1,500 yards, lowest bullet may strike at 1,275 yards.

Firing at 2,000 yards, lowest bullet may strike at 1,700 yards.

This 15 per cent. error expressed in angles will be the difference between the angles of tangent elevation for the ammunition in use.

Thus with Mark VII ammunition:—

500 yards tangent elevation ...	22' 0"
425 yards tangent elevation ...	18' 0"
Difference ... ..	4' 0"
800 yards tangent elevation ...	43' 0"
680 yards tangent elevation ...	33' 0"
Difference ... ..	10' 0"
1,000 yards tangent elevation ...	62' 0"
850 yards tangent elevation ...	48' 0"
Difference ... ..	14' 0"
1,500 yards tangent elevation ...	135' 0"
1,275 yards tangent elevation ...	98' 0"
Difference ... ..	37' 0"
2,000 yards tangent elevation ...	250' 0"
1,700 yards tangent elevation ...	177' 0"
Difference ... ..	73' 0"

If we now add the vertical dispersion of the lower half of the 100 per cent. cone ex-

pressed in angles, to the error 15 per cent. also expressed in angles, it will give the safety angle for each of these ranges.

500 yards 11' 0" plus 4' 0" ...	15' 0"
800 yards 11' 0" plus 10' 0" ...	21' 0"
1,000 yards 11' 0" plus 14' 0" ...	25' 0"
1,500 yards 15' 0" plus 37' 0" ...	52' 0"
2,000 yards 17' 0" plus 73' 0" ...	90' 0"

From the foregoing it will be seen that there is a different safety angle for each range. As it would unnecessarily complicate our card, and possibly lead to the wrong lines being used, we only use three angles, taking the angles at 1,000, 1,500, and 2,000 yards, and calling them 30', 60', and 100' respectively.

### Indirect Fire.

(For Vickers guns mounted on Mark IV tripods only.)

This is probably the most interesting part of Fire Direction. The possibility of firing from concealed positions well in rear of our own front line troops is very attractive, and especially so in trench fighting, where the positions of friendly troops and enemy lines are clearly marked.

But it is essential that machine gun officers should appreciate the true value of such fire.

Indirect fire will usually produce *moral* effect only—i.e., annoyance to the enemy.

Material effect can only be obtained when the machine gun officer:—

1. Has experience in this form of fire ; and
2. Secures observation of the strike of the bullets.

The experience required has for its foundation a thorough working knowledge of the range and trajectory tables, which include the following:—

- (a) Tables giving angles of elevation and descent.
- (b) Dimensions of cones of fire and beaten zones.
- (c) Safety limits for overhead fire.
- (d) Angle of sight formula.
- (e) Map reading and compass bearings.
- (f) An intimate knowledge of the elevating and traversing dials.

For the beginner the task is rather formidable, and young officers should not attempt firing indirectly—especially when the safety of our own troops is involved—unless they have a firm grip of the groundwork referred to above.

The necessary knowledge is only acquired in the usual way—*i.e.*, by close study of the figures given in the tables, followed by examples worked out on the map and ground.

The following methods of employing indirect fire are of a practical nature. The

instructions for the use of any particular method are clearly set forth and should be readily understood.

The rules laid down to ensure the safety of our own troops are based upon practical experience of machine gun fire at all ranges, and should be strictly adhered to, except under very special ground conditions.

The following methods are used as the conformation of the ground and circumstances permit :

1. SPIRIT LEVEL METHOD
2. GRATICULE METHOD
3. MAP AND COMPASS.
4. SPIRIT LEVEL AND ELEVATING DIAL.
5. LONG RANGE SEARCHING FIRE.
6. SEARCHING REVERSE SLOPES.

In all methods the greatest possible care in preparation is urged. It should be particularly noted that methods 1 and 2 must not be employed when firing over the heads of friendly troops, owing to the personal errors which may arise.

### **Spirit Level Method.**

(Not employed when firing over friendly troops.)

*Rules.*—1. The target must be visible to the section officer from a position in rear and above the gun.

2. The gun and target must be approximately on the same level.
3. The gun must be back far enough from the obstruction to ensure the bullets clearing it.
4. An observation post is essential.

### Method and Fire Orders.

(a) The section officer (from his position in rear) "dresses" the No. 1 gun and auxiliary aiming mark approximately in line with target.

(b) To No. 1.—"Sights to zero."—"Level gun" (spirit level used).

(c) To No. 2.—"Move auxiliary aiming mark to where line of sight is now pointing." (No. 1 looking through sights gives directions to No. 2.)

(It may not be necessary to move the aiming mark. If line of sight pointed to any part of it, No. 1 would note the exact spot.)

(d) To No. 1.—"1000"—i.e., range from gun to target as required.

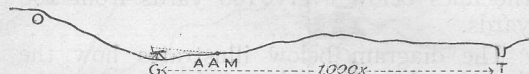
(e) To No. 1.—"Relay on auxiliary aiming mark."

(f) "Fire" (usually signalled).

(g) "Up" or "Down 100" as required.

(h) Deflection changes are made by ordering, so many taps right or left, as required.

### ILLUSTRATING THE SPIRIT LEVEL METHOD OF INDIRECT FIRE.



O=M.G. officer "dressing" gun on target for direction.

G=Gun position back from crest to ensure cone clears.

\*A.A.M.=Auxiliary aiming mark giving direction and horizontal line of sight when spirit level is on the gun.

1000\*=Sighting elevation used. (Weather conditions normal.)

Observation of results from "O" or other convenient position.

\* The further the auxiliary aiming mark is placed from the gun the greater will be the degree of accuracy.

### Graticule Method.

(Not employed when firing over friendly troops.)

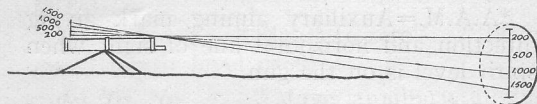
By means of graticules cut across the focal plane of a pair of field glasses, indirect fire

can be as commonly used and as quickly applied as ordinary direct fire.

These graticules represent the tangent angles of elevation for a machine gun. The topmost graticule represents zero, and the lines below every 100 yards from 200 yards.

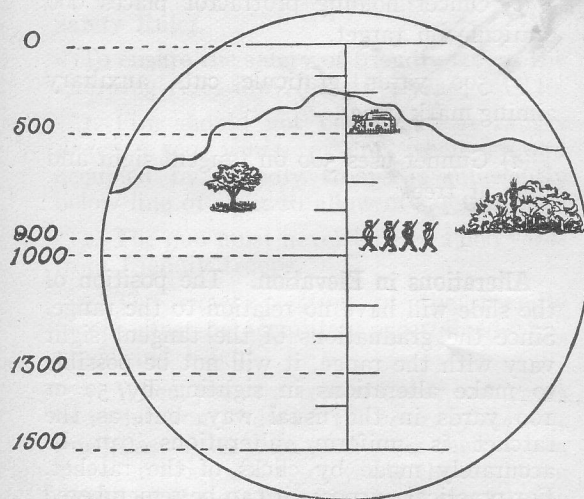
The diagram below illustrates how the lines forming the angles of elevations on the tangent sight may be intercepted at a convenient distance and used either on field glasses or a protractor.

FOCAL PLANE OF FIELD GLASSES GRATICULED.



- Rules.*—1. Obtain the range to the target.
2. Select an auxiliary aiming mark vertically above or below the target.
  3. Select a position from which both the target and aiming mark can be observed (not more than six feet *above* the gun).
  4. Look at the target so that the graticule representing the range falls across the target (see diagram).
  5. Note which graticule cuts the aiming mark above or below the target. This is the tangent elevation at which to open fire to strike the target (see diagram).

ILLUSTRATING THE USE OF GRATICULED GLASSES.



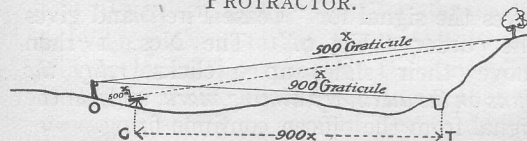
In the above diagram :

Range to target = 900 yards.

Auxiliary aiming mark cuts the 500 yards graticule.

*Fire Order.*—"500—At the House—Fire."

ILLUSTRATING USE OF GRATICULE CARD OR PROTRACTOR.



- (a) Range from gun to target = 900 yards.
- (b) Officer holding protractor places 900 graticule on target.
- (c) 500 yards graticule cuts auxiliary aiming mark (tree).
- (d) Gunner uses 500 on tangent sight and aims at tree.

**Alterations in Elevation.** The position of the slide will have no relation to the range. Since the graduations of the tangent sight vary with the range, it will not be possible to make alterations in sighting by 50 or 100 yards in the usual way, but, as the ratchet is uniform, alterations can be accurately made by clicks of the ratchet. For practical purposes it can be remembered that the number of clicks required in order to elevate the gun by 100 yards is the same as the number of hundreds of yards in the range. Thus, to move the slide from 1,200 to 1,300 yards requires 12 clicks. Example: Range being 900 yards, and shots are observed 100 yards short. Directing officer gives the signal for "Cease Fire" and gives the order "Up 9." The Nos. 1 then move their slides up 9 clicks, *relay the guns on the auxiliary aiming mark*, and, on the signal from the officer, continue firing.

### Indirect Fire Over Friendly Troops.

(Using Map and Compass.)

#### Safety Rules.

To ensure the safety of friendly troops the following rules must be strictly adhered to.

1. Fire should not be opened at ranges *under 1,500 yards*, except when ground occupied by friendly troops is sufficiently below line of sight to allow of safety limits.

2. The gun must never be *over 2,000 yards* from friendly troops.

3. The exact position of the friendly troops must be accurately ascertained—*i.e.*, range and height.

4. When friendly troops are 1,000 yards or under from the gun, the *centre of the cone* must pass at least 20 yards over their heads. Between 1,000 and 1,500 yards, the minimum height of the centre of the cone must be 40 yards. Over 1,500 and up to 2,000 yards this height must be 80 yards.

*Note.*—The trajectory table gives the height of the centre bullet of the cone above the horizontal plane. (See card in pocket of this book.)

5. When a *negative* angle of sight exists between gun and target, the trajectory used will be lower than that for the range, and its height should be checked to see that the necessary safety is assured (see examples).

6. When a *positive* angle of sight exists between gun and friendly troops, the height of the friendly troops must be deducted from the height of the mean trajectory before deciding the question of safety (see examples).

7. Climatic conditions must be carefully studied; especially rain, rear winds or extreme heat, all of which require less elevation, and result in a lower trajectory being used (see examples).

8. All calculations must be carefully checked before fire is opened.

9. Clinometers must be tested, and, if necessary, corrected before use.

10. Tripod legs must be heavily sand-bagged or firmly embedded in the ground.

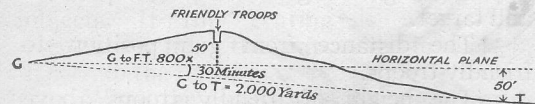
11. A worn or a nickelled barrel should not be used.

12. When traversing or searching fire is to be employed, the gun must be controlled within safe limits. A wooden batten or sandbags placed beneath the barrel casing will prevent the muzzle from being unduly depressed, and a stake on either side of the fore end of the barrel casing ensure the fire being kept within the proper limits.

13. The friendly troops should be cautioned when fire is to be opened.

14. A reliable gunner should fire the gun.

### ILLUSTRATING FACTORS WHICH AFFECT THE SAFETY LIMITS WHEN FIRING OVER FRIENDLY TROOPS.



1. Target never *less* than 1,500 yards from gun.

2. Gun moved so as to be never *more* than 2,000 yards from friendly troops.

3. Negative angle of sight between gun and target = 30 minutes, which reduces the trajectory from 2,000 to 1,900 yards (about).

4. Positive angle of sight between gun and friendly troops =  $1^{\circ}12' = 50$  feet. Therefore the 1,900 yards trajectory must reach a height of 60 feet, *plus* 50 feet, or 110 feet, at 800 yards, to be safe. The 1,900 yards trajectory does actually reach 129 feet above the horizontal plane at 800 yards, therefore the safety conditions are amply fulfilled.

5. Allowance for atmospheric influences is not considered in above. (See examples, page 213.)

**Barrage and Long Range Searching Fire.**  
(Using Map and Compass for range and direction, and Spirit Level, Elevating Dial or Clinometer for elevation.)

From the map the following information must be obtained:—

1. The exact position of the gun.

2. The direction or bearing of the target.
3. Distance from gun to target.
4. The angle of sight between gun position and target.
5. The distance from gun position to friendly troops.
6. The height of friendly troops above gun position.

### To Find Exact Gun Position.

First take the case where you have the gun in position on the ground but require to know your exact position on the map.

1. Look about for two or three prominent objects as nearly as possible at right angles to each other from your position, which are also shown on the map.

2. Next remove the gun or revolver that may be in the vicinity to a distance so as not to affect the compass, and take the bearings to the prominent objects.

3. Plot the back-bearing-lines on the map, using the protractor. The point where the lines intersect must be the spot on which you stand.

Now take the case where the gun position has been marked on the map and it is required to find it on the ground.

1. Using the protractor and map note the magnetic bearings of two well-defined objects which are easily seen from the required gun position.

2. Proceed to the neighbourhood of the required gun position, and with a compass take a bearing to one of the prominent objects. If this bearing is *under* that ascertained from the map, walk to the *left*; if *over*, to the right.

3. When the compass bearing corresponds with that obtained from the map you know that your gun position is somewhere on this line. Before turning to take a bearing to the second object it is sound to place two sticks in the ground on that bearing to ensure moving along the correct line when taking the bearing to the second object.

4. Now face the second object and take the bearing. If this bearing agrees with the one taken from the map, then the gun position is fixed. If not, proceed as when finding the first bearing, using the two sticks as *direction* posts.

### To Find the Direction of the Target.

#### (a) Direction by Compass Bearing.

1. On the map note the magnetic bearing of the target from the gun position.

2. On the ground, standing at the gun position with a compass, select some object the magnetic bearing of which is the same as that for the target.

3. Place the night firing box, or other suitable auxiliary aiming mark, in line with the gun position and the object selected.

4. Mount the gun and lay the sights on the auxiliary aiming mark.

**(b) Direction by Direction Dial.\***

The direction dial is a metal fitment graduated in degrees and attached to the socket of the Mark IV tripod. By this means the gun may be laid on any prominent object and then swung round in the required direction, the number of degrees forming the angle between the reference object and target, as follows :—

**On the Map.**

1. Select a reference object visible from the gun position.
2. Draw lines on the map from the gun position to the target and reference object.
3. Measure the angle formed by these lines with a protractor.

**On the Ground.**

1. Lay the gun on the reference object.
2. Note the reading on the traversing dial.
3. Swing the gun round through the required number of degrees.
4. Place out an auxiliary aiming mark 10 yards in front of gun to maintain direction.

**To Find the Distance to the Target.**

1. Consult the scale of the map. If an English map is being used, this will be pro-

\* **Laying the Gun on a Compass Direction.**—A compass is taken out 20 yards more or less in the direction in which the gun is going to fire, and a bearing is taken on the gun.

At the same time No. 1 lays the gun on the compass and then notes carefully the figure on the traversing dial.

The reading on the compass is the back bearing of the

vided with a scale in yards, and you will find scales of yards on your protractor, equivalent to various scales of inches to the mile.

2. If a foreign map is being used scaled on the metric system, the distances given in metres may be readily converted into yards or feet.

One metre equals 1.094 yards, or 3.28 feet, or 39.37 inches. Therefore, when wishing to find the equivalent number of yards, feet, or inches, when a metre scale is used, multiply the number of metres by the figures given above.

3. Place the scale flat on the map with the zero point on the gun position and note the number of divisions on the scale opposite the target. Use the smaller divisions on the left of the scale to measure short distances and work for accuracy to the nearest possible yard.

**To Find the Angle of Sight between Gun and Target.**

1. From the map contours note the difference in height between the gun position and target.

direction in which the gun is laid. Subtract 180 degrees in order to obtain the direction of the gun.

Call out to No. 1 the number of degrees right or left necessary to get the gun pointing in the direction previously determined upon.

No. 1 taps the gun through the required number of degrees. At once place out an auxiliary aiming mark in the direction found.

2. Convert the height found in (1) to minutes as follows :—

$$\frac{\text{Difference in height in inches}}{\text{Number of hundreds of yards in range}} = \text{Angle of sight in minutes.}$$

Examples—

(a) Target 50 feet below gun position.  
Distance, 2,000 yards.

$$\frac{50 \times 12}{20} = -30 \text{ minutes angle of sight.}$$

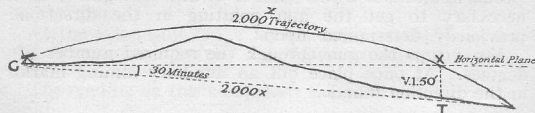
(b) Contours marked in metres. Difference in height, 20 metres. Range, 2,000 yards.

$$\frac{20 \times 40}{20} = 40 \text{ minutes angle of sight.}$$

In this case the metres are reduced to inches by multiplying by 40, there being 39.37 inches in a metre.

By the above simple formula the angle of sight is found quickly and accurately within the "holding" powers of any gunner.

As the target is *below* the gun position, the angle of sight must be *deducted* from the angle of tangent elevation. When the target is above the gun the angle of sight must be added. (See diagram.)



The above diagram illustrates how the centre of the cone will pass through X on the horizontal plane and miss the target, unless the angle of sight of 30 minutes is deducted from the angle of tangent elevation for the range.

In this case the angle of tangent elevation for 2,000 yards = 4 degrees 16 minutes. From this must be deducted the angle of sight of 30 minutes.

$$\begin{array}{r} 4^{\circ} 16' \\ - 30' \\ \hline 3^{\circ} 46' \end{array}$$

The result is the quadrant elevation to be placed on the gun.

3. Other methods of finding the angle of sight are as follows :—

(a) *By the Topographical formula—*

$$D = \frac{VI \times 19.1}{HE}$$

where VI = Difference of height in feet.

HE = Distance in yards.

D = Angle of sight in degrees.

In the example given the VI = 50 feet, and HE = 2,000 yards. Therefore by formula

$$\frac{50 \times 20}{2000} = \frac{1}{2} \text{ degree} = 30 \text{ minutes.}$$

(b) When metre contours are in use—

$$D = \frac{VI \times 65}{HE}$$

where VI = Difference in height in metres.

HE = Distance in yards.

D = Angle of sight in degrees.

In the example given on the previous page the VI = 20 metres, and the HE = 2,000 yards.

Therefore by formula

$$\frac{20 \times 65}{2000} = \frac{13}{20} \text{ degrees} = \frac{13}{20} \times \frac{60}{1} = 39 \text{ minutes.}$$

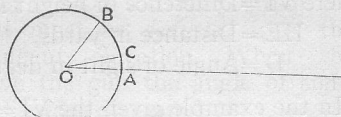
(c) By M.G.T.C. Formula—

$$\frac{VI \text{ (in yards)}}{HE \text{ (in yards)}} \times 3,400 = \text{minutes.}$$

Simple Explanation of the Formula—

$$D = \frac{VI \times 3400}{HE} \text{ minutes.}$$

DIAGRAM  
I.



If you describe any circle, and lay out round the circumference a length equal to the radius, the arc so formed will subtend an angle of  $57^{\circ} 17' 45''$ , or  $57.3^{\circ}$ .

This is nearly  $60^{\circ}$ , so we may say that an angle of  $60^{\circ}$  drawn from the centre of a circle will cut off the circumference an arc equal in length to the radius.

(See Diagram 1.)

Now suppose we divide this arc AB into 60 equal parts, and we also divide the radius OA into 60 equal parts, each of these small parts on the arc equals each small division of the radius as radius and arc are equal.

But as the arc BA subtends an angle of  $60^{\circ}$ , each small division on the arc subtends an angle of  $1^{\circ}$ .

Now let us draw a piece of the arc AC, so that the angle COA so formed equals  $15^{\circ}$ . Then the angle COB equals  $45^{\circ}$ .

It is clear that there must be 15 small divisions along the arc from A to C and 45 from C to B. But each small division on the arc is the same size as each small division on the radius OA.

Thus we can equally well say that we could fit in 15 of the small OA divisions between A and C and 45 between C and B.

But  $\angle ACO = 15^{\circ}$ , and  $\angle COB = 45^{\circ}$ .

Therefore it appears that there are as many degrees in the angle as we can fit radius divisions into the arc cut off by the angle.

Now each radius division =  $\frac{1}{60}$  of the arc. Thus, to find out the angle in degrees, we have only to divide the arc by  $\frac{1}{60}$  of the radius.

$$\text{Angle in degrees} = \text{Arc} \div \frac{\text{Radius}}{60} = \frac{\text{Radius} \times 60}{\text{Radius}}$$

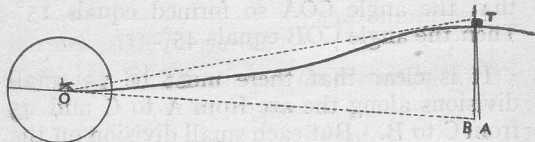
To explain this step, take any simple equation:—

$$\frac{12}{2} = \frac{12 \times 2}{2}$$

Both are equal to the same thing, *i.e.*, 4.

Now suppose a gun to be placed at O (see *Diagram 2*), and we wish to find the angle of sight to a target at T.

DIAGRAM II.



It will be clear that, no matter what the size of the circle, the above relation—

$$D^{\circ} = \frac{\text{Arc} \times 60}{\text{Radius}}$$

—will hold good.

Let us suppose, then, that a circle is described round the gun position, cutting the target vertically. As we are dealing with very small angles, we can assume the perpen-

dicular drawn from T to the radius at B to be equal to the length of the arc TA.

Thus we have—

$$\text{Angle TOB in degrees} = \frac{\text{TB} \times 60}{\text{Radius OB}}$$

or—

$$\text{Angle of sight} = \frac{\text{VI} \times 60^{\circ}}{\text{HE}}$$

But it will be remembered that the real figure was 57.3, and not 60. So our statement should read as follows:—

$$\text{Angle of sight} = \frac{\text{VI} \times 57.3^{\circ}}{\text{HE}}$$

But it is more convenient to be able to find the angle direct in minutes, so we multiply by 60, which is the number of minutes in a degree.

So now we have—

$$\text{Angle of sight in minutes} = \frac{\text{VI} \times 3438}{\text{HE}}$$

3438 is not an easy figure to have to work out, so we call it 3400.

$$\therefore \text{Angle of sight} = \frac{\text{VI} \times 3400}{\text{HE}} \dots \text{minutes.}$$

The above explanation aims at being understood (not necessarily remembered) by

the most elementary mathematician, and could, of course, be compressed as found convenient.

NOTE.—The word "Formula" frightens people who are unused to figures, and in consequence does not occur in the above explanation.

### **To Place the Quadrant Elevation on the Gun.**

#### **(a) By Spirit Level and Elevating Dial.**

1. Level the gun, spirit level on breech casing, No. 1 taking "holding" pressure.
2. If necessary move elevating dial until zero mark is under the pointer.
3. Clamp elevating dial, taking care not to turn the elevating wheel.
4. Remove spirit level and, reading the graduations on the elevating dial carefully, place the required elevation on the gun, No. 1 taking "holding" pressure all the time.
5. To maintain the elevation during firing, No. 1 next raises the tangent sight and adjusts the slide until the line of sight cuts the auxiliary aiming mark, but without touching the elevating wheel.
6. During pauses in the firing the gun should be levelled and the position of the elevating dial checked, and if necessary re-adjusted as in 2 and 3.

#### **(b) Quadrant Elevation by Clinometer.**

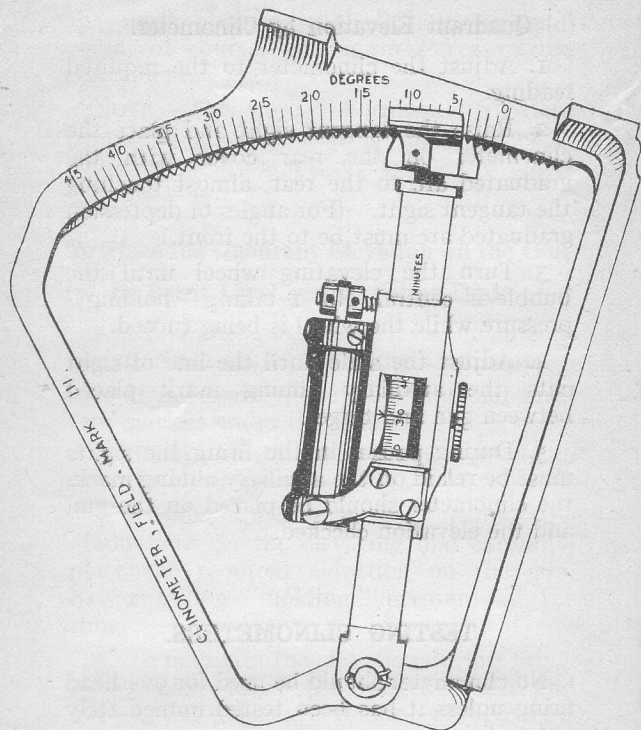
1. Adjust the clinometer to the required reading.
2. Raise the tangent sight and place the clinometer on the rear cover with the graduated arc to the rear, almost touching the tangent sight. (For angles of depression graduated arc must be to the front.)
3. Turn the elevating wheel until the bubble is central, No. 1 taking "holding" pressure while the wheel is being turned.
4. Adjust the slide until the line of sight cuts the auxiliary aiming mark placed between gun and target.
5. During pauses in the firing the sights must be relaid on the auxiliary aiming mark, the clinometer should be placed on the gun and the elevation checked.

### **TESTING CLINOMETERS.**

No clinometer should be used for overhead firing unless it has been tested immediately before firing.

#### **To Test the Accuracy of the Clinometer.**

1. Select a gun and mounting which have very little play.
2. Mount the gun with the socket upright.



3. Set the clinometer to zero and place it on the rear cover with the graduated arc to the rear.

4. Move the elevating wheel until the bubble is central. (No "holding" pressure required.)

5. Reverse the clinometer, placing it in exactly the same position.

6. If the bubble reads centrally the instrument is accurate.

If the bubble does not return to the central position, the error may be found as follows:—

1. Loosen the adjusting nuts (see plate) and move them till the pivoted end of the level is slightly higher than the other end.

2. Set the clinometer to zero and place it on the gun with the graduated arc towards the muzzle. Move the elevating wheel so that the bubble is central.

3. Reverse the instrument and it will be found to read a plus reading.

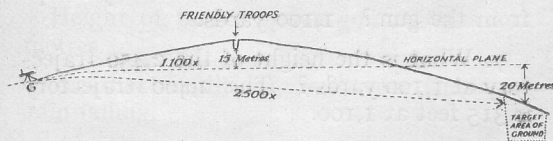
4. Halve the reading; the result gives the minus error of the instrument.

5. Set the clinometer to read its error. Place it on the gun and centre the bubble. The gun is now level.

6. Set the clinometer to zero, place it on the gun and adjust the nuts until the bubble becomes central. The instrument now reads correctly.

#### EXAMPLES OF LONG RANGE SEARCHING FIRE.

##### EXAMPLE I.



Range from gun to nearest point of target area = 2,500 yards.

Range from gun to friendly troops = 1,100 yards.

Height of friendly troops above gun = 15 metres.

Height of gun position above target = 20 metres.

Weather conditions normal.

### Reasoning and Calculations.

1. What is the tangent elevation for 2,500 yards? Table gives 447'.

2. What is the angle of sight between gun and target? Formula  $\frac{20 \times 40}{25} = -32'$ .

3. The quadrant elevation to go on the gun is therefore 415'.

4. What is the equivalent range to the quadrant elevation? The table gives 2,450, about.

5. What is the error of the day? Nil.

6. At what distance are the friendly troops from the gun? 1,100 yards.

7. What is the height of the 2,450 trajectory at 1,100 yards? The 2,400 trajectory is 315 feet at 1,100.

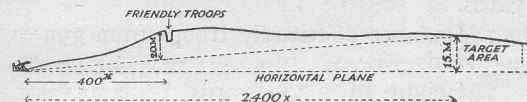
8. What is the height of the friendly troops? 50 feet.

9. What is the corrected height of the centre of cone above the friendly troops?  $315 - 50 = 265$  feet.

10. What is the safety height required for 1,100 yards? 125 feet. Therefore a very large margin of safety is assured.

CLIMATIC CONDITIONS UNFAVOURABLE AND FRIENDLY TROOPS 400 YARDS FROM GUN POSITION.

### EXAMPLE II.



Range from gun to nearest point of target area = 2,400 yards.

Range from gun to friendly troops = 400 yards.

Height of friendly troops above gun position = 20 metres.

Height of target above gun position = 15 metres.

Weather conditions, fresh rear wind and rain falling.

**Reasoning and Calculations.**

1. Tangent elevation for 2,400 yards = 401'.

2. Angle of sight gun to target =  $\frac{15 \times 40}{24}$   
= +25'.

3. Quadrant elevation therefore = 426'.

4. Equivalent range to quadrant elevation = 2,450 yards (about).

5. Allowance for climatic conditions. Two influences requiring *less* elevation = -150 yards.

6. Minimum trajectory to be used = 2,300 yards.

7. Distance of friendly troops from gun = 400 yards.

8. Height of 2,300 yards trajectory at 400 yards = 120 feet.

9. Height of friendly troops above gun = 20 metres = 66 feet.

10. Corrected height of trajectory above friendly troops = 54 feet.

11. Safety height required for 400 yards = 60 feet. Therefore it is just unsafe to open fire.

**Night Firing.**—If the gun position is not exposed to the enemy's fire, the gun, if not otherwise required, can be mounted and laid by day, and left till night.

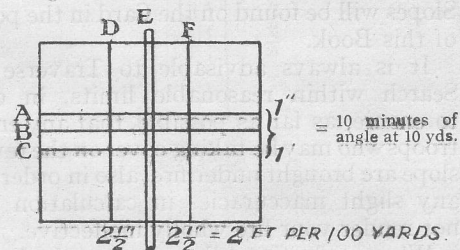
A stick is placed in the ground 10 yards in front of the gun in a direct line with the target.

At *night* this stick is replaced by a lamp, and the sight altered (but not the gun) until the sights are aligned on the lamp. This ensures accurate re-laying should the gun shake off during firing.

In order to align the sights on a light, it is necessary that a beam 9 inches broad at 10 yards be used. Diagram P shows the form of front for the lamp, which allows of searching within definite limits by means of auxiliary aiming marks.

**NIGHT FIRING SCREEN.**

Lines on face of screen for Searching and Traversing, lit up with electric torch or siege lamp.



Bands A, B, C, D, F are  $\frac{1}{2}$  inch wide.  
DIAGRAM P.

The tangent sight slide should be adjusted so that the line of sight is directed at the intersection of the lines B E. The lines A C are respectively 1 inch above and below line B; if the lantern is placed 10 yards away from the gun, these lines will give a difference of angle of 10 minutes from the normal line B. The amount that 10 minutes represents in range can be calculated from the tables of elevation. The firer can be ordered to concentrate by firing with the original laying or to search within definite limits by varying his aim from line A to line C.

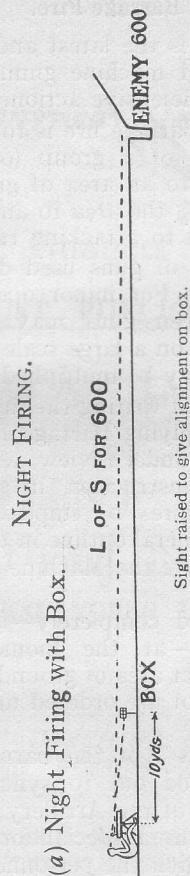
Deflection can also be ordered by means of the lines D and F, which are  $2\frac{1}{2}$  inches from the centre line, giving therefore a deflection of about 2 feet per 100 yards.

### Searching Reverse Slopes.

The general method of Searching Reverse Slopes will be found on the Card in the pocket of this Book.

It is always advisable to Traverse and Search within reasonable limits, in order to ensure, as far as possible, that any enemy troops who may be taking cover on the reverse slope are brought under fire, also in order that any slight inaccuracies in calculation shall not render your fire wholly ineffective.

When selecting the angle of descent from the table it is better to select an angle slightly steeper than that formed by combining 1 and 2. (See card.)



### Barrage Fire.

Barrage fire is the latest and most useful development of machine gunnery both for offensive and defensive action.

To employ Barrage fire is to scientifically apply the fire of a group (or groups) of machine guns to an area of ground with a view to denying the area to an enemy or to give protection to attacking troops.

The number of guns used depends upon the operation. For minor operations four, eight, or sixteen guns may be required. For operations on a large scale the numbers given above may be multiplied ten times.

At the time of writing the most successful methods of applying Barrage Fire in recent operations are under review, with a view to co-ordinating instruction in this subject. It will, therefore, be impossible to give more than a general outline in these notes.

To be effective the Machine Gun Barrage must :

1. Be applied completely—*i.e.*, guns fire simultaneously—at the moment ordered, and on the exact area of ground.
2. The rate of fire ordered must be maintained.
3. The "lifts" of the barrage must be carefully worked out to synchronise with the movement of the Artillery barrage.

To ensure this a special form of drill is necessary in which the personnel of batteries

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or groups of guns is trained until a sound system of control and supply is established.

The barrage may be of long duration and will break down if the supply of ammunition, water, or oil fails.

The preparation and distribution of duties may be briefly summarised as follows:

### **Corps M.G.O. and M.G.C.C.**

The arrangements for the barrage for the whole Corps front may be co-ordinated by the Corps M.G.O. under the orders of the Corps Commander.

Similarly, the Divisional or Brigade Machine Gun Company Commander may be ordered to make arrangements. In which case the following appears to be a reasonable method of getting to work:

1. Ascertain the points on the map where the barrage is required.
2. Find out how many guns or companies will co-operate.
3. Decide in conference with other Company Commanders the general distribution of guns.
4. Work out clearances, cones, etc., plotting cones of fire as they should appear on ground.
5. Decide on area of ground to be allotted to each group or battery.
6. Issue definite orders to Group or Battery Commanders.

### **Group or Battery Commanders.**

1. Determine exact positions for guns.

2. Check angles of Quadrant Elevation and also direction angles.

3. **Arrange for**—Depression stops under guns which have only just the necessary clearances.

4. Improvement of gun platform.
5. Concealment and cover.
6. Water, oil, and S.A.A.
7. Reliefs for firers.

### N.C.O. Gun Team Commanders.

1. Assist in control and regulation of rate of fire, or—
2. Supervise belt filling.
3. Assist in carrying out repairs.
4. Organise ammunition and water supply, etc.

### Gunners.

The most important duties are :

1. Put out auxiliary aiming screen.
2. Sandbag tripod.
3. Arrange spare parts, spare barrel, oil can, cleaning rod, etc., in a convenient position close at hand.
4. Recovery of aim between bursts.  
(This is most important.)
5. Use of intervals between fire to re-oil, refilling belts, water supply, repairing locks etc.

The above form a few of the many points demanding attention for the production of a successful barrage, the details of which must become second nature by constant training and rehearsal.

DETAILS (incomplete) OF MACHINE GUNS USED BY VARIOUS POWERS

Country.	Name of gun and weight in lbs.	How cooled.	Mounting and weight in lbs.	How loaded.	Maximum fire per min.	How Transported.	Organization, etc.
Austria ...	Schwarzlose (R) 38	Water Jacket	Tripod 40	Belt of 250 rds	375	Pack	Sec. 2 guns Infy, 4 guns Mountain troops and Cav. About 1 gun per 600 rifles.
Belgium ...	Maxim (R)	Water Jacket	Tripod on carr.		600	Draught (Dogs)	
Brazil ...	Maxim (R) Nordenfeldt (R)	Water Jacket	Tripod	Belt of 250 rds	600	Pack	Sect. 3 guns.
Bulgaria	Maxim (R) 35	Water Jacket	Sledge with detachable wheels.	Belt of 250 rds	600		Section 2 guns peace, 4 war.
China ...	Maxim (R)						16 companies: 9 guns.
France ...	Hotchkiss (G) 53, Model 1907 (G) 52	Both Air Cooled Radiators	Cav. tripod on wheeled carr. Inf. tripod 73	Flat charger of 24 rounds	600	Cav. draught Infy. Pack	4 per Inf. Rgt. 2 per Chasseur Bn. 2 per Cav. Bde. Being increased to 2 per Battn and Cav. Rgt.
Germany	Maxim (R) Infy, 40; Cav. 58	Water Jacket	Sledge, Infy 53; Cav. 110	Belt of 250 rds	600	Draught	Det. or Coy, 6. Also Armoured motor cars 6 guns per Bde = 1 gun per 1,000 rifles.

DETAILS (incomplete) OF MACHINE GUNS USED BY VARIOUS POWERS.

Country.	Name of gun and weight in lbs.	How cooled.	Mounting and weight in lbs.	How loaded.	Maximum fire per min.	How Transported.	Organization, etc.
Gt. Britain	Maxim (R) 58 Vickers (R) 27	Water Jacket	Tripod 48	Belt of 250 rds	600	(a) Limbered carr. (b) Pack	Company 16 guns.
Greece ..	Maxim (R)	Water Jacket		Belt of 250 rds	600		4 Batteries: 24 guns
Holland	Schwarzlose (R) 44	Water Jacket	Sledge forming tetrapod, 77	Belt of 250 rds		Limbered wagon	Det. (mid) peace 4 guns, Co. (dismltd) war 8 guns.
Italy ..	Perino (R) 48 Maxim (R)	Water Jacket	Tripod 44	Hopper fed with flat chgrs of 30 rounds	450	Pack	Section 2 guns.
Japan ..	38th Year (G) 70	Air Cooled Radiators	Tripod 30	Flat charger of 30 rounds	600	Pack	Battery 4 guns Cav. 6 guns Infy.
Montenegro	Maxim						12 guns, possessed.
Norway ..	Hotchkiss (G)						Detmt, 4 guns.
Portugal	Maxim (R)	Water Jacket	Wheeled carriage	Belt of 250 rds	600	Draught	2 secs each 4 guns with each of six Rifle Battalions.
Roumania	Maxim (R)	Water Jacket	Sledge	Belt of 250 rds	600	Draught	6 per regiment.
Russia ..	Maxim (R) 63 Vickers (R) 27	Water Jacket	Wheeled carriage with trail 485, or tripod, 45 lbs	Belt of 250 rds	600	Infy. pack, replacing draught. Cav. draught	Det. 8-gun, 4-gun, 2-gun wheeled equip and 4-gun pack equip

222

Servia ..	Maxim (R)	Water Jacket				Pack	Infy and Cav. Rgt 2 in peace, 4 in war. Eventually 2 per battalion of 1st Bat.
Spain	Maxim (R) Hotchkiss (G)	Water Jacket Air Cooled Radiator					1 group, 2 secs = 4 guns (Maxim). 5 groups, 10 secs = 20 guns (Hotchkiss). Maxim Sect. has water mule.
Sweden ..	Hotchkiss (G)	Air Cooled		Flat chgrs of 30	600		3 guns per sqdm.
Switzerland	Maxim (R)	Water Jacket	Tripod and Ref (porter's cradle) carriage	Belt of 250 rds	600	(a) Pack; (b) cradle on man's back	Company 6-8 guns. Groups 3 companies.
Turkey ..	Maxim (R) 40 Hotchkiss (G) 83	Water Jacket Air Cooled Radiator	German sledge 53 lbs	Belt of 250 rds Flat chargers of 30 rds	600	Draught	Company 4 guns.
U.S.A. ..	Maxim (R) 58	Water Jacket	Tripod	Belt of 250 rds	600	Pack	Platoon 2 guns.

223

Remarks: (R) = Recoil-operated. (G) = Gas-operated. The weight for water-jacketed guns does not include the weight of water, which is from 7 to 9 lbs.

In Germany the sledge mounting is transported on a wheeled carriage which carries 2 guns and sledges.

Belgium possesses 40 Hotchkiss for mobile defence of fortresses.

In Switzerland the company is sub-divided into sections with 2 or 4 guns.

France also uses Hotchkiss Portative.

Russia also uses Rexer.

Russia has 6 Rexers per Cav. Rgt, also (now being discarded for 2 Maxims. Rexers only used for advanced patrols).

Denmark, 4 Rexers (on saddle) per Sqdm of Hrs.

Sweden, 2 Rexers per section in the Infantry.

Norway } Use Rexers for Cavalry

China }

Uruguay uses Rexer for Infantry and Cavalry.

U.S.A. uses Hotchkiss Portative under the name of Benet Mercié.

## THE LEWIS MACHINE GUN.

### Manufacturers' Notes.

#### SPECIAL FEATURES.

*Simplicity.*—The attainment of ultimate simplicity has been successfully studied in every detail of the gun design. No part of the mechanism is complicated or hard for even the untrained layman to understand.

*Few Parts.*—There are only sixty-two parts in the gun proper, exclusive of the accessories which are not part of the gun. The parts cannot be wrongly assembled, and when in place require no adjustment.

*Cooling System.*—The method of cooling employed in this gun is as simple in principle as it is effective in practice. No moving parts are employed. Closely fitting the steel barrel is a cylindrical jacket of aluminium having deeply cut longitudinal grooves throughout its length and circumference. Over this aluminium jacket there is a thin tubular steel casing, the muzzle end of which extends at reduced diameter beyond the end of the jacket and barrel. The jacket and tubular casing, together with the barrel mouthpiece, constitute the entire cooling system. The specially shaped barrel mouthpiece screwed to the end of the barrel serves the double purpose of firmly securing the radiator in place and of so directing the powder blast at each discharge as to greatly increase the "ejector action" of this blast in

sucking cool air from in rear through the longitudinal grooves (air passages) of the radiator. The tubular steel casing serves to confine the blast of cool air within the course of the air passages and hence in contact with the aluminium of the radiator. The high specific heat, the great heat conductivity, and the low specific gravity of aluminium, combined with an exceedingly simple and durable construction, thus produce a cooling system for the gun that is at once practical and efficient, without rendering it too heavy or bulky for general field service. No extra barrel is carried on the firing line, *and water is never needed for cooling purposes.*

*Velocity.*—Another useful effect incident to the cooling system is the increase of velocity, due to prolonging the gas pressure upon the bullet after the latter has left the muzzle. This increase of muzzle velocity is more than sufficient to compensate for the loss of the slight amount of gas energy required to operate the gun mechanism, and it is found in practice that the gun gives a slightly greater velocity to the bullet than can be obtained from the same length of barrel in a shoulder arm firing the same ammunition.

*Recoil Checking.*—There is almost no noticeable recoil when the gun is fired. This is due to the fact that the design found to give best results for air cooling also proves effective in practice in reducing the recoil,

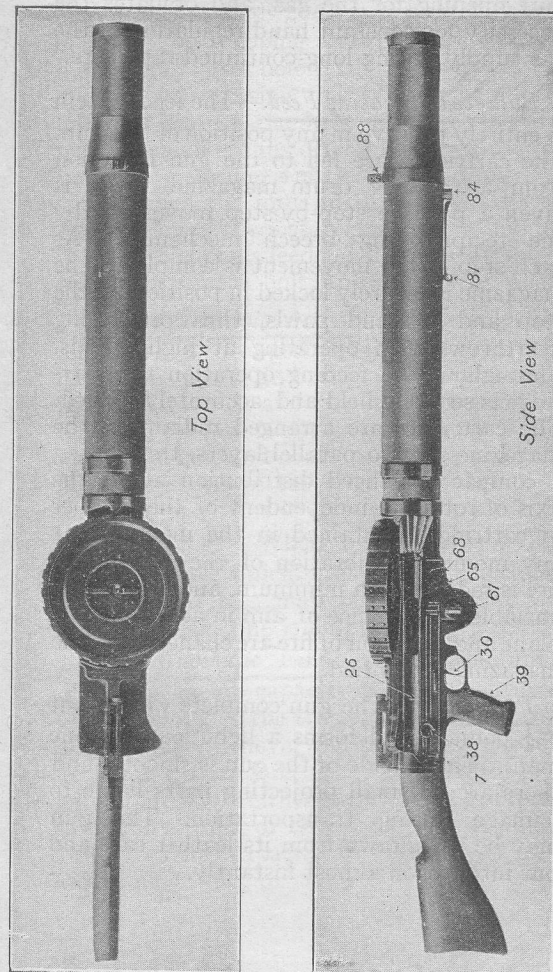
through the friction of the powder blast on the inner walls of the barrel mouthpiece and tubular casing.

Mounting the Gun.—The very small amount of free recoil makes the problem of mounting the gun a very easy one. A heavily built man can do accurate shooting from the shoulder without a mount of any kind. The gun may be fired in any position from any sort of improvised mount. The ejection being to the side does not interfere with placing the gun as close to the ground as may be desired. For general use in the field a light portable form of support is recommended, but to meet any special condition of service, such, for instance, as arise in the arming of aeroplanes or dirigibles, a special form of mount is recommended. Any existing type of machine gun mount can be adapted to the Lewis gun.

Moving Parts.—The number and weight of the moving parts have been reduced to an approximate minimum, thus reducing the amount of live gas needed for operation, and effecting a material saving of wear and shock to those parts.

Durability.—Exhaustive endurance trials have made it possible to select for each part the material and design calculated to give the maximum length of useful service.

Gas Regulation.—The special form of gas regulator employed permits the use of a fixed



GUN COMPLETE, WITH MAGAZINE AND RIFLE BUTTSTOCK.

port opening for the gas, and obviates the necessity for constant hand regulation of the gas supply during long-continued rapid fire.

*Balanced Magazine Feed.*—The feed system is entirely positive in any position of the gun. The cartridges are fed to the gun in action from a rotating drum magazine, which is given a positive step-by-step movement by the reciprocating breech mechanism. As each step of the movement is completed the magazine is securely locked in position by the stop and rebound pawls, thus preventing overthrow when operating at high speeds. Throughout the feeding operation the cartridge is securely held and accurately guided. The cartridges are arranged radially in the magazine in two parallel layers, thus giving a compact balanced distribution about the axis of rotation, independent of the number of cartridges contained in the magazine at any moment. Vibration of the gun during fire is reduced to a minimum, and there is no variable disturbance of aim in action as the plane and direction of fire are changed and the magazine is emptied.

*Portability.*—The gun complete weighs but 25½ pounds, and forms a light load for one man. The outside of the gun is smooth, and there are no small projecting parts liable to damage during transportation. The gun may be withdrawn from its leather case and put into action almost instantly.

*Operation.*—The gun is operated automatically by trapping a small portion of the live powder gases before the bullet leaves the muzzle, and causing this portion of gas to impinge against the head of a free moving piston, which is thus driven back against the force of a spring, and is returned by this spring when the force of the gases is spent. The motion of the piston is utilized to unlock the breech bolt, feed in a new cartridge, relock the breech bolt, and fire.

*To Put Gun into Action.*—When a loaded magazine is dropped into place over the magazine post, and the charging handle pulled to the rear as far as it will go and then released, the gun is put into action by a pull on the trigger, and continues to fire until the finger pressure on the trigger is released or until the magazine is empty.

*Single Shots.*—When the trigger is pulled once and very quickly released a single shot is fired, and this may be repeated at will until the magazine is empty.

*Semi-Automatic Fire.*—Within the limits of the magazine capacity the gun continues to fire so long as the trigger is held back, and stops firing whenever the trigger is released. It follows, therefore, that the operator may at will fire shots either singly, or in groups of two, three, four, or of any number up to the full magazine capacity of forty-seven cartridges.

*Full Automatic Fire.*—Continued pressure on the trigger results in full automatic fire which need be interrupted only by the four second intervals required to replace emptied magazines by loaded ones.

## LEWIS MACHINE GUN.

*Method of imparting instruction.*

### General Description.

*Name.*—Lewis Machine Gun. .303. Air cooled and gas operated.

*Weight.*—26 lbs.

*The gun is worked by two forces :—*

- i. The force of the gas.
2. The return spring.

*NOTE.*—Do not talk too much about things that cannot be seen, wait for these until the gun is stripped.

*The Gun is divided into two portions :—*

1. The stationary portions.
2. The moving portions.

The *stationary* portions consist of :—

- (a) The barrel group ;
- (b) The body group.

(a) **The barrel group consists of :—**

- i. The **barrel** (the spare barrel should be shown, in order to avoid withdrawing the barrel from the radiator).

Calibre .303, with a right-handed twist to the rifling.

It is threaded at the front end to take the *barrel mouthpiece* which has a left-handed

thread, to prevent it being detached from the barrel during firing.

A *gas vent* is bored in it 4 inches from the muzzle, to allow the gas to pass into the gas chamber.

A square thread is cut at the rear end for attachment to the *body*.

A *stud* is placed in front of the square thread to fit in a slot in the radiator, and align it with the barrel.

ii. The **radiator** is of aluminium, and has projecting flanges and is split longitudinally, and sprung on to the barrel.

It assists in dissipating the heat of the barrel.

A *recess* for the gas chamber is provided at the forward end, and a *flat* which corresponds with one on the *radiator casing* is made at the rear end to assist in alignment to allow for rotation of magazine.

iii. The **radiator casing** consists of front and rear portions and is connected by the *clamp ring*.

The rear portion has a hole cut in it to allow the entrance of the *gas regulator*.

A *flat* is provided at the rear end to correspond with the flat on the radiator, and the rear face is drilled to admit the barrel and gas cylinder, and also the *body locking pin*.

The front portion is tapered and extends beyond the barrel mouthpiece.

On both portions are *recesses* to take the stud on the clamp ring.

The *clamp ring* is turned up at both ends to form foresight protectors, and the inner portion on the right side forms the foresight *block* and is dovetailed to receive the foresight. It is held in position by a screw.

iv. The **gas chamber** is connected to the barrel by a band which fits round the barrel, and at the forward end fits into a recess in the barrel, which is cut round the gas vent.

It is drilled and tapped to receive the gas cylinder and gas regulator, and has wings which the stripping spanner grips when screwing it up.

v. The **gas regulator** screws into the gas chamber and has two holes, either of which can be placed opposite the hole in the rear face of the gas chamber.

It is operated and held in position by means of the *gas regulator key*, for which a recess is cut in the gas regulator.

The *key* is sprung in and out of a hole in the rear radiator casing by means of a *loop* large enough to take the point of a bullet.

vi. The **gas cylinder** is tapped at the front end to screw on to the gas chamber, and is shaped at the rear end to admit the rack on the piston.

The body group consists of :—

i. The **body** is tapped to screw on to the barrel, and is drilled to take the locking pin,

and a groove is cut through which the pin is operated when stripping the gun.

*Bottom.*—Underneath the body is a pin on to which the pinion casing, hooks and openings are cut to allow the pinion, plunger and sear to enter.

Guide grooves are also made to take the pistol grip, and the catch on the buttstock.

*Sides.*—Openings are cut on either side of the body in which the *cocking handle shank* can travel as required, and a *sliding plate* with a recess and a thumb piece is provided for safety purposes.

On the right side of the body is the ejection slot.

*Top.*—The body carries on top the *magazine post*, which is hollowed and coned to actuate the magazine when placed in position.

A key is placed on the exterior to prevent the centre block of the magazine from rotating.

The top of the body is slotted throughout the greater part of its length, the front part of the slot taking the form of a cartridge, while in the rear portion fits the boss on the feed arm actuating stud.

The *ejector seating* lies on the left of the slot, and is closed by a spring cover, and a hole is drilled in the body into which the stud on the centre of the ejector fits.

A *groove* is cut at the rear end of the body

in which the stud on the tail of the feed arm runs.

*Interrupted projections* are provided to lock the body cover.

*Interior.*—Inside the body are drilled the *bolt way*, and the *piston rod channel*.

The bolt way has four grooves placed in the form of a cross, which admit the lugs on the bolt, and on the feed arm actuating stud.

Recesses are provided at the forward end of the bolt way in which the lugs on the rear end of the bolt lie, when the bolt is closed.

Slots are cut in the interior of the bolt way to allow the ends of the ejector to project alternately into the bolt way.

The *piston rod channel* is flat-bottomed to take the *rack*.

ii. The **body cover** fits on top of the body.

The projecting *tongue* at the front end has underneath it a *seating* for the cartridge guide spring.

Under the body cover are the *axis studs* for the *stop and rebound pawls*.

*Projections* to engage with the projections on the body are provided at the sides.

Fixed to top of the body cover by a screw is the *back sight bed*.

The *tangent sight leaf* is hinged to it, and held in position by a spring.

The *tangent sight* is of the aperture pattern, and is actuated by an elevating screw which

is operated by a *milled head* with a *nib and spring*.

The *cartridge guide spring* is held in position by an undercut recess, and has a stud which fits in a hole in the tongue.

The two ends of the spring are turned over, and the left hand end lies over the right, and controls it.

The *stop and rebound pawls* pivot on the studs, the right pawl lying above the left pawl, the head of which is enlarged to bring it on a level with the under side of the cover.

A flat spring lies behind the pawls, and a stud on its back fits in the rib behind it.

Part of the left of the spring is turned over to embrace the pawl.

iii. The **pinion casing** is shaped to contain the pinion and spring.

At the front end is the *hook* which engages it to the body, and at the rear end is the *pinion pawl*, a rib on one arm of which engages in the pinion and is kept in action by a spring which bears against the back of the arm.

The other arm of the pawl projects from the casing and is lifted by the trigger guard as the latter is slid into position, thus disengaging the *rib* from the pinion.

The casing is drilled to take the tension screw.

iv. The **trigger guard and pistol grip** consist

of a frame which is channelled to contain the plunger, trigger and sear.

It extends to form the trigger guard and pistol grip.

Guide grooves to connect it with the body are left on the sides.

At the forward end is a recess for the pinion pawl.

The plunger is a cover for the trigger spring and is slotted to take the front end of the trigger.

The sear and trigger are both pivoted on axis pins and the jaw on the rear end of the trigger controls the sear.

At the rear end is the butt catch with a spiral spring.

v. The butt has on the front face the butt cap. Projections are provided for attaching it to the body, and a recess into which the tooth on the butt catch fits.

It acts as a stop for the bolt and piston, and also locks the component parts of the body group.

**The moving portions consist of :—**

i. The piston rod, which is in two parts and joined by a pin, to compensate for any slight want of alignment between cylinder and body.

The head is cupped, grooved and ringed, and the rings tend to make a gastight joint,

and scrape away any fouling which accumulates.

Under the rear portion of the piston is a rack, and behind the rack is the bent which engages with the nose of the sear.

On top is the striker post, which is drilled for the striker, and is secured by a fixing pin.

A slot for the cocking handle is cut in the rear end.

ii. The bolt has on the face a rim to support the base of the cartridge.

Gaps are cut for the extractors which lie in recesses cut in the surface of the bolt.

The extractors are flat springs with a hook on the head to engage with the rim of the cartridge, and a stud which fits in a recess in the bolt and takes the pull of extraction.

Grooves are cut in the slot into which the tail of the extractor is sprung, and these tend to keep it pressed inwards.

A slot cut in the rim allows the ejector to enter.

A cammed slot is cut inside the bolt in which the striker post travels.

Four lugs at the rear end take the shock of discharge, and the rear face is tapped to take the feed arm actuating stud.

iii. The feed arm actuating stud screws into the rear of the bolt, has lugs which work in the guideways, and prevent it from turning,

and a *boss* which travels in the long slot in the body and actuates the *feed arm*.

iv. The **feed arm** has an axis hole which passes over the magazine post, and a recess to clear the key on the post, when stripping.

A hinged *latch* secures the feed arm to the post.

A slot is cut to allow the cartridge to pass from the magazine to the body, and a raised *stop* holds the cartridge in position during the movement of the feed arm.

Behind this are the *axis*, *stop* and *spring retaining studs* for the *feed arm pawl*.

The *pawl* has a hole for the axis stud and a slot in which the spring lies, while underneath is a recess for the stop stud and a stud for the *loop* on the spring.

The tail of the feed arm is grooved underneath to receive the boss on the feed arm actuating stud, and the *tail* is curved.

At the end of the tail is a *stud* which works in the shallow groove in the body.

v. The **pinion** is bored to admit the tension screw, and has an *internal recess* to correspond with a *projection* on the spring casing, to lock the two parts.

The *spring drum* has a *hub* which is tapped for the tension screw and is slotted to take one end of the *return spring*, which is coiled inside the spring casing and attached to it by two studs.

vi. The **magazine** is a circular pan with *rectangular indentations* on the rim, inside which are riveted plates to hold the base of the cartridge.

A *ring* carrying 25 *pegs* is riveted over a hole which is cut out of the centre of the pan.

The pegs and indentations hold the cartridges in position, and force them round when the pan is rotated.

Twenty-five recesses for the nib on the magazine catch are provided inside the ring and pan.

A *steel disc* covers the central hole with a channel in it for the *magazine catch and spring*.

A *thumbpiece* is cut in the centre of it.

A *hook* is formed on the bottom of it with a sloping head to engage below the cone on the magazine post.

A *spiral spring* lies in the channel and keeps the nib pressed into one of the recesses in the ring and pan.

A *centre block* with a spiral channel, in which the bullet ends of the cartridges lie, is riveted to the centre disc, and keeps the magazine catch in position in the channel.

In the centre is the hole for the magazine post, and a keyway is cut to fit the key on the magazine post.

The magazine catch locks the centre block to the pan, and prevents it from rotating when not in position.

The **cartridge guide spring** is held in position by an undercut recess, and has a stud which fits in a hole in the tongue.

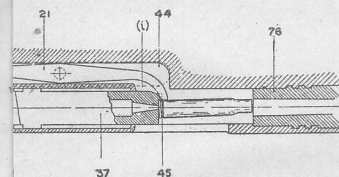
The two ends of the spring are turned over, and the left-hand end lies over the right, and controls it.

The **stop and rebound pawls** pivot on the studs, the right pawl lying above the left pawl, the head of which is enlarged to bring it on a level with the under side of the cover.

A flat spring lies behind the pawls, and a stud on its back fits in the rib behind it.

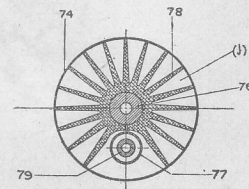
Part of the left of the spring is turned over to embrace the pawl.

To face page 240.



EJECTING A CASE

FIG. 4



SECTION THROUGH A.B.

FIG. 2

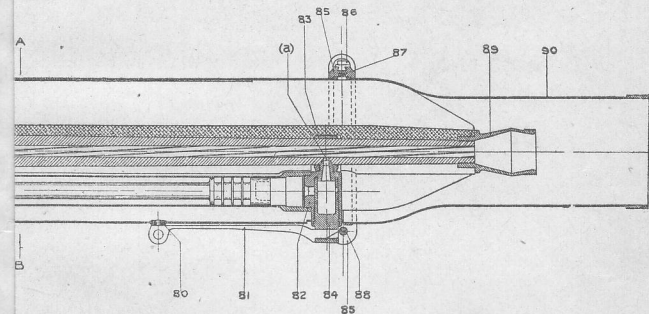


PLATE I.

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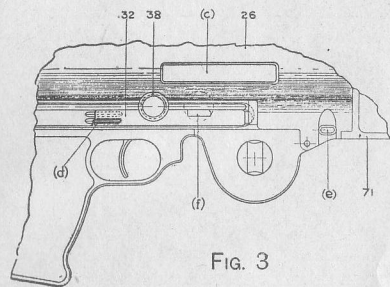


FIG. 3

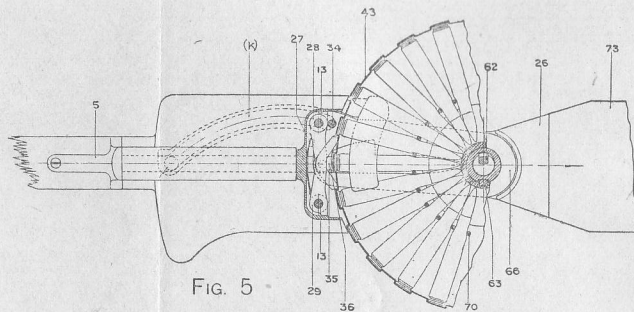
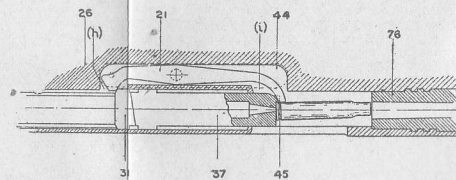
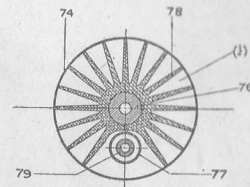


FIG. 5



EJECTING A CASE

FIG. 4



SECTION THROUGH AB

FIG. 2

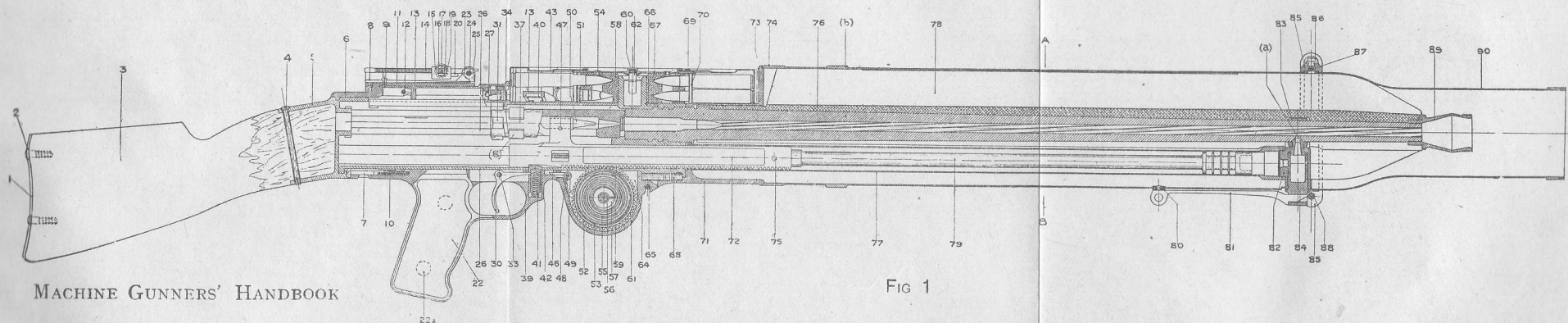
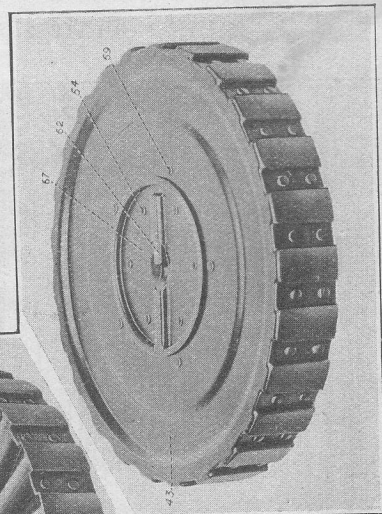
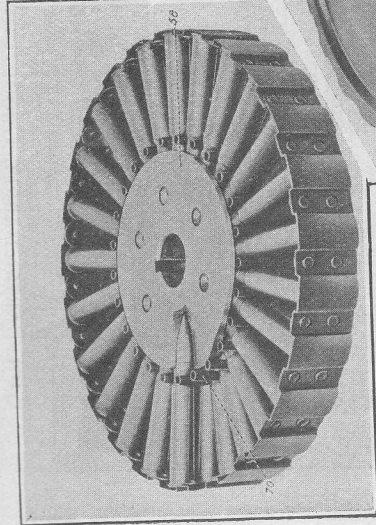


FIG. 1

MAGAZINE BOTTOM VIEW.

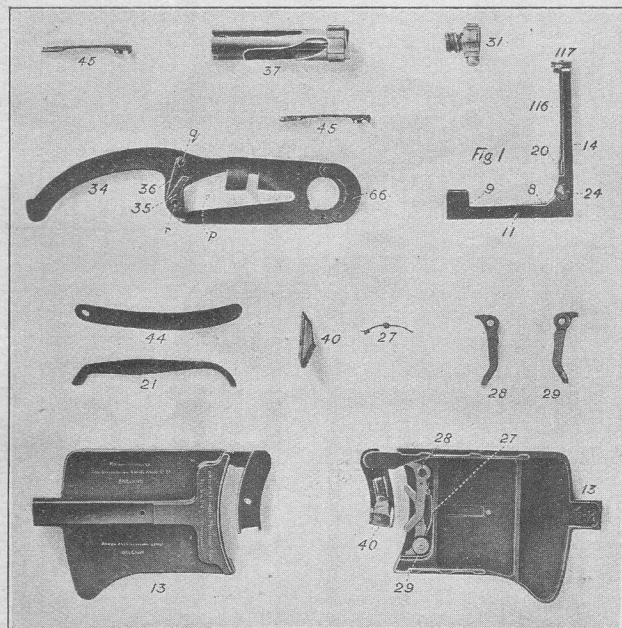


MAGAZINE TOP VIEW.



## GUN PARTS: FEED MECHANISM, BOLT, EXTRACTORS AND EJECTOR.

PLATE 4.



### MECHANISM.

### SEQUENCE OF INSTRUCTION.

1. How to load.
2. How to fire.
3. Unload.
4. Action of the explosion on all moving portions.
5. Action of the return spring.

*During the teaching of mechanism, practice should be given in the following subjects :—*

1. Removing the bolt.
2. Removing the magazine.
3. Changing cartridge guide spring.
4. Replacing any of the pawls and springs.

### MECHANISM.

1. Show how to put on the magazine and load.

*Note.*—Show each action as it takes place. Dummies should also be used.

The magazine should be removed after the first cartridge has dropped, to show the action clearly.

## Load and Explain.

2. That (a) on pressing the trigger, the gun fires. (b) On releasing the trigger the gun stops in a fully cocked position, with a live round under the cartridge guide spring.
3. When the powder gases expand through the gas vent into the gas chamber, and pass through the hole in the gas regulator,
  - (a) The piston is forced back, and the rack on its under side, working in the pinion, winds

up the return spring and the bent passes over the nose of the sear.

(b) The striker post bearing against the cammed slot in the bolt (after the first  $1\frac{1}{2}$  inches of travel) rotates the bolt and frees the lugs from the recesses in the body, and the rear part of it then bears against the cammed slot, forcing the bolt further back, till piston and bolt reach the butt cap.

(c) The bolt by means of the extractors withdraws an empty case from the chamber, and in its backward travel pushes the tail of the ejector out of the boltway, the head swinging into the boltway and ejecting the empty case.

(d) The boss on the feed arm actuating stud carries the feed arm over to the left, and the feed pawl, which is bearing against a projection on the magazine, carries the pan round with it.

(e) A cartridge is forced down the slope of the centre block, and when the bullet end falls clear of lip on to the cartridge opening in the feed arm, the tongue on the body ensuring that the cartridge drops.

It is carried to the left by the indentations and separating pegs of the magazine, and forced under the cartridge guide spring.

The stop on the left side of the feed arm controls it in this position.

(f) The spring stud on the feed arm moving to the left releases the stop pawl, which is pushed forward by its own spring, and

engages in the indentations on the magazine and prevents it rotating too far, while the rebound pawl is pressed back, as the magazine moves to the left, and then comes forward again.

4. (a) *Pressing the trigger* disengages the bent from the sear, and the unwinding of the return spring actuates the rack and forces piston forward.

(b) *The striker post*, being unable to rotate the bolt owing to the lugs being in the guide grooves, carries the bolt forward.

(c) The face of the *bolt* in its forward movement meets the cartridge and pushes it into the chamber, the cartridge stop controlling it during movement. The front of the bolt pushes the head of the ejector out of the boltway, and the tail swings in. The extractors spring over the rim of the cartridge as it goes into the chamber. When the bolt is fully forward the lugs are clear of the grooves.

(d) *The feed arm actuating stud* is carried forward with the bolt, and the boss carries the feed arm over to the right; the feed arm pawl passing over a projection on the magazine and engaging behind it, while the spring stud presses the stop pawl out of the path of the magazine, the rebound pawl preventing the magazine from slipping back.

(e) *The striker post* rotates the bolt and locks the lugs in the recesses in the boltway, and the striker, passing through the face of

the bolt, strikes the cap and explodes the charge.

5. (a) If the trigger is instantaneously released after pressing it, single—or at times two—shots will be fired according to the rapidity with which the sear rises and engages with the bent.

(b) If pressure is maintained, the gun will continue firing until the magazine is empty.

### Stripping.

#### TO STRIP AND ASSEMBLE THE GUN.

Although the gun may be taken apart starting with the mechanism in any position, it is best whenever practicable to see that the magazine is removed, the chamber empty, and the charging handle at the extreme forward end of its stroke, before commencing to disassemble. If this procedure is followed there will be no need to readjust the main-spring tension or to make any other adjustment when the gun is reassembled.

To disassemble the gun, insert the point of a bullet into the slot leading to the butt latch (Plate 1, No. 7) and push forward against the force of the butt latch spring. At the same time twist the buttstock (Plate 1, No. 3) up and to the left, then remove by withdrawing it to the rear. This removes the buttstock group which should not be further disassembled.

Next hold back the trigger (Plate 1, No. 30), and pull back the guard (Plate 1, No. 39)

until clear of the receiver (Plate 1, No. 26). This removes the guard, which contains the trigger mechanism and butt latch.

Pull down on the gear casing (Plate 1, No. 61) until it drops clear of the rack (Plate 2, No. 72).

Pull back the charging handle (Plate 1, No. 38) until it reaches the end of its slot, then withdraw by pulling it out away from the receiver.

Withdraw the operating rod complete and the bolt complete by pulling them both together to the rear until clear of the receiver.

With the point of a bullet push back on the receiver lock pin (Plate 1, No. 68), then twist the receiver (Plate 1, No. 26) up and to the left and unscrew it from the barrel.

The foregoing operations divide the gun into convenient groups of parts, the detailed stripping of which will now be described.

### DETAILED STRIPPING.

#### BUTTSTOCK GROUP.

It is best never to strip this group, but if found necessary the screws securing the buttplate and butt tang to the buttstock are readily removed.

#### RECEIVER GROUP.

See that the feed operating arm (34) is pushed to the right, then pull back and remove the feed cover (13).

*Feed Cover.*—From the feed cover the stop

pawl (28), rebound pawl (29), and cartridge guide spring (40) are readily removed with the point of a bullet. On Plate 4 these parts are seen in place inside the feed cover.

*Back Sight.*—The back sight (Plate 4, Fig. 1) may be stripped from the feed cover by removing the bed spring screw (11).

*Feed Operating Arm.*—Remove the feed operating arm complete (Plate 4, Nos. 34, 35, 36, 66) by pushing forward on the feed operating arm latch (66), and then lifting clear of the magazine post (Plate 3, *u*). The feed pawl (35) and feed pawl spring (36) are removed from the feed operating arm by lifting them clear of the studs (*r*) and (*q*). The latch (66) should not be removed.

*Ejector.*—(Plate 4, Nos. 44, 21). With the point of a bullet lift and pull out the ejector cover (44) and the ejector (21).

*Safety.*—The safeties (Plate 3, No. 32) may be prised out of the receiver with a bullet point.

The gear case hinge pin (65) and the centre key (63) are permanently assembled and should not be removed.

*Gear Casing.*—Push forward and remove the receiver lock pin (Plate 3, No. 68) and unhook the gear casing (61) from the gear case hinge pin (65).

The receiver group is now completely stripped.

### MAINSPRING GROUP.

To strip completely the parts (Plate 3, Nos. 61, 46, 56, 52, 57, 53, 55, 49, 48, 59) found assembled in the gear casing (61), raise the gear stop (46) with the point of a bullet, and allow the mainspring to unwind.

*Gear.*—Then unscrew the collet pin (56) and shake out the gear (52).

*Mainspring.*—Pushing with a bullet through the gear against the mainspring collet (57) forces out the mainspring casing (53) from which the mainspring (55), with its locating rivets (59) and the mainspring collet (57) may also be removed by the use of a bullet.

*Gear Stop.*—The gear stop (46) and gear stop spring (49) should not be stripped, but in case of necessity they may be removed by driving out the gear stop pin (48).

### GUARD GROUP.

The assembled guard (Plate 3, Nos. 33, 120, 30, 91, 42, 41, 121, 7, 10) contains the trigger mechanism and the butt latch. To strip this group, punch out the trigger pin (33) and the sear pin (120).

*Trigger.*—Pull back on the trigger (30) and lift it out.

*Sear.*—Remove the sear (91), sear spring box (42) and sear spring (41).

*Butt Latch.*—Punch out the butt latch pin (121) and remove the butt latch (7) and butt latch spring (10).

In ordinary practice the guard group need never be stripped.

#### BOLT AND ROD GROUP.

The bolt and rod group comprises the bolt complete and the operating rod complete. These two assembled parts are withdrawn together from the receiver, and may then be separated by lifting the bolt clear of the operating post (*m*) on the rod.

#### BOLT COMPLETE.

(Plate 4, Nos. 31, 45, 37.)

*Feed Operating Stud.*—Unscrew and remove the feed operating stud (31) from the rear end of the bolt.

*Extractors.*—The extractors (45) are spring-tempered and are sprung into place. To remove insert the point of a bullet under the extractor claw and push the head of the extractor out and away from the bolt. At the same time draw the whole extractor forward until it is clear of its seating.

*Bolt.*—The bolt (37) is now completely stripped.

#### OPERATING ROD COMPLETE.

(Plate 2, Nos. 79, 75, 72, 50, 47.)

This assembled piece is ordinarily never stripped.

*Piston.*—The piston connecting pin (75) is riveted in place, but may readily be punched out in case it is desired to remove the piston (79).

*Striker.*—The striker (50) may be withdrawn after punching out the striker fixing pin (47).

#### BARREL GROUP.

(Plate 2, Nos. 81, 84, 88, 85, 86, 87, 90, 74, 71, 77, 89, 82, 76, 78, 83.)

*Gas Regulator.*—Lift out the gas regulator key (81), then unscrew and remove the gas regulator cup (84).

*Clamp Ring.*—Using the gas regulator key as a tool, unscrew the clamp ring screw (88) and remove the clamp ring (85) which carries the front sight (86) and the clamp ring positioning screw (87).

*Radiator Casing.*—Pull forward the radiator casing front (90), and pull back the radiator casing rear (74) which is permanently assembled to the radiator casing rear locking piece (71).

*Gas Cylinder.*—Unscrew and remove the gas cylinder (77), using the operating rod as a wrench.

*Gas Chamber.*—Unscrew the gas chamber (82), using, if necessary, the barrel mouth-piece wrench (Plate 2, Fig. 1).

*Barrel Mouthpiece.*—Unscrew the barrel mouthpiece (89), remembering that the thread on this piece is left-handed.

*Barrel.*—Drive out the barrel (76) from the radiator (78). (This operation may conveniently be accomplished before removing the barrel mouthpiece, by unscrewing the latter part way and then allowing the barrel and radiator to drop from a height of two or three feet on to a solid piece of wood, striking on the front end of the barrel mouthpiece. The weight of the radiator dropping from this height will usually loosen the barrel sufficiently so that it can be simply withdrawn by hand from the radiator, after the mouthpiece has been removed.)

*Gas Chamber Band.*—Lift out the gas chamber band (83) from its recess in the radiator.

The stripping of the barrel group is now complete.

#### ASSEMBLING.

By reversing the operations just given for stripping the assembling of the gun is readily and quickly carried out. The following points, however, should be noted:

1. Be sure that the gas chamber band (83) is correctly inserted into its place in the radiator before the barrel (76) is pushed home, and that the barrel is turned so that the gas port (*a*) is at the bottom.

2. In replacing the bolt and operating rod the cam slot in the bolt (37) is slipped over the striker (50), and the feed operating stud (31) is screwed into the bolt as far as it will go.
3. After inserting the bolt, rod, and charging handle (38), the charging handle is then carried forward to the extreme end of its stroke before the gear casing (61) is swung up into place and the rack engaged.
4. **The mainspring is wound up** by engaging the rack and gear, disengaging the guard, and pulling back on the charging handle until the required tension is obtained. The gear is then disengaged, the charging handle moved completely forward, the gear re-engaged, and the guard pushed home.
5. To reduce the tension of the mainspring proceed as follows:
  - REMOVE THE BUTTSTOCK.
  - DISENGAGE BOTH GUARD AND GEAR.
  - MOVE THE CHARGING HANDLE PART WAY BACK.
  - RE-ENGAGE THE GEAR AND GUARD
  - REPLACE THE BUTTSTOCK.

## MAINSRING TENSION.

The ideal condition exists when the strength of the mainspring exactly balances the opposing force of the gas striking the piston head. When this condition is realized all parts of the gun are subjected to a minimum of shock and wear. The attainment of the exact point of balance is of no practical importance, for the gun will operate satisfactorily over a wide range on either side of this point. Besides, the exact point is subject to constant slight fluctuations, due to the variable frictions caused by oil or lack of oil, and the accumulation or removal of foreign matter within the mechanism. But a little attention paid by the gunner toward getting an approximate balance between gas and spring will be well repaid in increased reliability of action and longer life of the gun parts.

For a given setting of the gas regulator to low limit for the working tension of the main spring is the point at which misfires occur. The high limit is reached when the force of the gas is no longer sufficient to drive back the mechanism far enough to feed the succeeding cartridge. The gun will operate on any spring tension between these limits.

At the approximate point of balance the bolt and rod barely touch the butt tang at the rear end of their stroke. Below this point the butt tang is being hammered with unnecessary force, and above it the action of the gun is faster than normal.

As already pointed out, conditions inside the gun may vary the point of balance, hence it is sometimes advisable to increase the spring tension in order to overcome some added friction or prevent misfiring; or to slow down the rate of fire by slightly decreasing the tension.

An average working tension for the mainspring is **between twelve and fourteen pounds**, as measured by holding back the trigger and pulling back on the charging handle with a small spring balance such as is supplied with the gun.

## GENERAL NOTE.

*Before Firing.*—See to it that the bore is clear, that the working parts are properly lubricated with good mineral oil and move freely, and that the tension of the mainspring is sufficient to avoid misfires.

*After Firing.*—See that the gun is immediately unloaded, and that the bore, working parts, and bearing surfaces are carefully examined, cleaned, and properly lubricated as soon as possible.

It is especially important to oil the piston head and the inside of the gas cylinder; and to remove oil, and replace the gas regulator cup.

Burrs found raised on any working part should be removed, and any roughening on a bearing surface should be smoothed down with fine emery or an oilstone.

## STOPPAGES.

### EXPLANATORY NOTES.

I.—I. It should be taught in drill that when the gun stops with the cocking handle in forward position the firer immediately tries to rotate the magazine in the feeding direction to find out whether it is empty.

The gun has been known to stop with C.H. *nearly* forward and to carry on suddenly after a pause of about one second. This is probably due to friction causing the bolt to be slow in rotating.

The slight pause in trying to rotate the magazine would allow for this.

2. (a) A *weak* S. and R. pawl spring would allow magazine to be dragged back one space each time by the feed pawl.

(b) A *broken* S. and R. pawl spring would allow the stop pawl to drop slightly from its position and obstruct the feed pawl, thus preventing C.H. from being drawn back more than about two or three inches.

II.—I. (a) If a *badly* bulged round were drawn under the C.G. spring it might cause a fault in feed—No. IV position.

This would be discovered during the carrying out of the Immediate Action, and might necessitate the removal of the body cover.

2. A Maxim or Vickers gun clearing plug can be used. This necessitates removal of the body from the barrel. The use of the clearing plug may be shown during instruction in mechanism.

Separated cases are not likely to occur frequently, and only if the bolt is much worn and does not close the breech securely.

III.—(a, b) Hard extraction may be due to abnormal expansion of a cartridge in exploding, or to dirt or fouling in chamber. The extra force exerted in extracting the case from the chamber (or in overcoming friction of any kind) may prevent the piston-rod from completing its backward travel. The bolt moves back far enough to eject the empty case, but not far enough to engage behind the next live round which is being drawn into position. The bullet of this round has *dipped* during the rotation of the magazine, and bearing against the *lip* of the *centre block*, prevents the magazine and feed arm from going back to their original position.

This can very easily be demonstrated with dummy cartridges.

IV.—(a) The point of bullet may have dipped, allowing bolt to catch against the under side of case, *or* bullet may have risen and caught against front end of cartridge-opening. A fault in feed may occur on rare occasions with a perfectly sound cartridge guide spring, owing to the spring not having had time to act properly.

(b) Faulty extraction might possibly be caused by brass filings (scraped off cartridges by the extractors) getting into the extractor seatings, but this should seldom occur if these are cleaned out periodically.

If the empty case cannot be removed from chamber with the point of another bullet or with a small screwdriver, a cleaning rod must be used.

(c) On pulling back C.H. live round will probably drop into bolt-way.

#### GENERAL.

If on releasing the trigger the gun does not stop firing, the cause will probably prove to be dirt or excessive oil under the plunger, preventing it from rising and thus holding the sear down.

The effect of a too weak or strong return spring is to cause a more rapid rate of fire and excessive wear and tear to the gun.

A good normal weight is 13 or 14 lbs.

### TEMPORARY STOPPAGES.

Position of Cocking Handle.	Immediate Action.	Probable Cause.	Method of Preparation for Instructional Purposes.
I In forward position.	1. Try to rotate magazine. (a) If free, change it.	(a) Empty magazine.	(a) Put on an empty magazine. <i>For Range Purposes.</i> Load with a magazine having only a few cartridges in it.
	(b) If fixed, pull back the cocking handle.	(b) Miss-fire	(b) Load and press the trigger. <i>For Range Purposes.</i> Load with a magazine having a dummy between the live cartridges.
	(ii.) If, after trying 1(b), the gun still does not fire, remove magazine, pull back cocking handle and see if cartridge is ejected. (a) If a cartridge is ejected, press the trigger, change piston rod.	(iii.) (a) Broken striker.	(ii.) (a) Load and press trigger. After No. 1 has performed 1 (b) the instructor says: "Gun still does not fire." <i>For Range Purposes.</i> Load with a magazine having two dummies between the live cartridges.
	(b) If no cartridge is ejected, examine rim of magazine, also the pawls and pawl-springs. Press the trigger, change component if necessary.	(b) No rotation of magazine due to damaged magazine, or pawls, or pawl springs.	(b) Remove feed arm pawl, load and press trigger. After No. 1 has performed 1 (b) the instructor says: "Gun still does not fire." <i>For Range Purposes.</i> Remove feed arm pawl, load and place a cartridge in the chamber.

## TEMPORARY STOPPAGES—continued.

Position of Cocking Handle.	Immediate Action.	Probable Cause.	Method of Preparation for Instructional Purposes.
I. In forward position—continued.	(iii.) If, after trying i (b), the cocking handle will not come back, remove the magazine and use "wooden handle," strap or cord. Press trigger.	(iii.) (a) Damaged magazine. (b) Hard extraction. <i>Note.</i> —If the cocking handle comes back easily after removing magazine the stoppage was probably due to the rim being damaged.	(iii.) Place a slightly bulged dummy cartridge first in the magazine, load, and press the trigger. <i>For Range Purposes.</i> Place a slightly bulged dummy cartridge about tenth in the magazine.
II. Over thumb piece on safety catch.	Pull back cocking handle and continue firing. If stoppage occurs again turn large hole in gas regulator to the rear and oil all working parts.	(a) Hard extraction. (b) Friction in gas cylinder or working parts of gun. <i>Note.</i> —The gas cylinder, gas chamber, and regulator may have to be cleaned out.	(a) Load. Then ease cocking handle forward whilst pressing the trigger. (b) Set up as for (a) and after No. 1 has been remedied, the instructor sets up again and says: "Fires a few and stops again."
III. Cocking handle nearly back—i.e., behind thumb piece.	i. Examine ejection opening: (a) If clear, pull back cocking handle.  (b) If, on pressing trigger the cocking handle does not fly forward, raise the safety catch, remove magazine and cartridge, examine	(a) Slight fault in feed.  (b) Broken cartridge guide spring.	(a) Load. Then ease cocking handle slightly forward whilst pressing the trigger. <i>For Range Purposes.</i> (b) Remove cartridge guide spring. Load.

262

## TEMPORARY STOPPAGES—continued.

Position of Cocking Handle.	Immediate Action.	Probable Cause.	Method of Preparation for Instructional Purposes.
	cartridge guide spring. Replace if broken. Press trigger. (c) If little or no resistance is felt in pulling cocking handle, remove magazine. "Unload without firing," change and adjust return spring.  (d) If cocking handle cannot be pulled back, remove magazine and change it. 2. If empty case in chamber, pull back cocking handle, raise the safety catch. Remove magazine. Push back the cartridge under the cartridge guide spring, drive back the empty with cleaning rod. Depress safety catch. (a) If the rim is cut by extractors, continue firing.	(c) Broken return spring. <i>Note.</i> —Change pinion without removing pinion casing. (d) Damaged magazine rim or catch.	(c) Release return spring, re-assemble. Load and press trigger, easing cocking handle forward.
	(b) If rim is cut by one extractor, or not at all, "Unload without firing," change bolt.  (i.) If empty case is in ejection opening, or on face of bolt, pull back cocking handle, raise safety catch, remove, empty, examine ejector. If broken, remove magazine, depress safety catch. "Unload without firing," change ejector.	(a) Hard extraction.  (b) One or both extractors, weak or broken.  (i.) Broken ejector.	(a) Load. Place empty case with rim notched in two places in chamber. Press trigger, easing cocking handle forward. (b) Load. Place empty case with rim notched in one place in chamber. Press trigger, easing cocking handle forward. (i.) Remove ejector. Load, press trigger, easing cocking handle forward. Place empty case in ejection opening. <i>For Range Purposes.</i> Remove ejector.

263

**MEMORY TABLE.**

In abbreviated form.  
**Temporary Stoppages, Lewis Gun.**

Position.	I. A.	Probable Causes.
1st	1. Try to rotate magazine : (a) If free, change it. (b) If fixed, pull C.H. back. 2. If second missfire : (a) Change piston rod. (b) If no rounds ejected, look for broken pawls and springs. 3. If C.H. will not move, use strap.	(a) Empty maga- zine. (b) Missfire. (a) Broken striker. (b) Weak or broken pawls or springs. Hard extraction.
2nd	Pull C.H. and fire. If recurs, oil up and turn gas regulator.	Hard extraction. Friction.
3rd	1. Examine ejector opening : (a) If clear, pull C.H. and fire. (b) If C.H. does not go forward, change cart. guide spring. (c) If C.H. moves easily, change return spring. (d) If C.H. will not move, change magazine. 2. If obstruction in opening or chamber clear it, look for damaged extractors or ejector.	1. (a) Slight fault in feed. (b) Broken cart- ridge guide spring. (c) Broken return spring. (d) Damaged maga- zine. 2. Broken extrac- tors. Broken ejector.

**Lewis Stoppages in Tabloid.**

Position.	Causes.
1st	(a) Magazine : Empty or damaged. (b) Missfire : Broken striker or defective cart- ridge. (c) Pawls or Springs : Damaged. (d) Hard extraction.
2nd	Friction or Hard Extraction.
3rd	(a) Fault in Feed } Cartridge guide spring. } Damaged magazine. (b) Return Spring : Broken. (c) Extractors } Broken. Ejector       }


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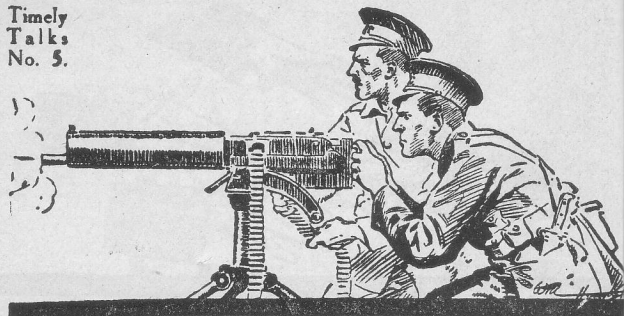
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